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West Europe Report

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No. 102

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WEST EUROPE REPORT

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CONTENTS

BRIEFS

EEC BIOMOLECULAR ENGINEERING PROGRAM--Brussels--Adopted last 7 December (decision of the Council, published in the JOURNAL OFFICIEL of the EEC, on December 30, 1981), the EEC research and training program for biomolecular engineering (in the form of indirect action) covering the period of April 1982 to March 1986 will affect the six following topics: 1) development of new reactors using multi-enzyme immobilized systems, including systems which require multiphase environment and cofactor regeneration; 2) development of bioreactors for human detoxification; 3) transfer of genes of various origins to Escherichia coli bacterium, Sacharomyces cerevisiae yeast, and other appropriate organisms; 4) elaboration of cloning methods; 5) transfer of genes to microorganisms and plants with agricultural value; 6) improvement of detection methods for contaminations, and of evaluation of possible risks associated with the application of biomelecular engineering in agriculture and industry. The first phase of the program will begin on 1 April 1982 and end on 31 March 1984 when it is expected that a decision for review will have been reached. [Text] [Paris CHIMIE ACTUALITES in French 29 Jan 82 p 20] 11,023

RECOMMENDATIONS ON GENETIC MANIPULATION--On 26 January, in Strasbourg, the parliamentary assembly of the European Council approved proposed recommendations on genetic manipulation. Presented by Bjoern Elmquist (Danish Liberal) for the legal implications and by Lennart Pettersson (Swedish Social-Democrat) for the scientific and technological ones, these proposed eight-point recommendations provide for "specific acknowledgement" in the European Convention on the Rights of Man, of the "right to a genetic legacy which has undergone no manipulation except in the application of certain principles recognized as fully compatible with respect for the rights of man." Also recommended are the framing of a European agreement on what constitutes legitimate application of genetic engineering technology to human beings; the establishment of a list of severe malignant diseases susceptible to treatment by genetic therapy with the consent of the party involved; the definition of principles regulating the collection, storage, and utilization of genetic data on individuals; and the examination of protection standards for the health and safety of the general public and of laboratory workers. The authors of the project also request the coordination of European measures to guarantee this safety; examination of proposed recommendations from the Council of European Communities concerning records of experiments involving genetic recombinants; and lastly, examination of patentability of genetically modified microorganisms. [Text] [Paris AFP SCIENCES in French 28 Jan 82 p 7] 11,023

CSO: 3102/194

FRENCH COMPANY EXCHANGES FRENCH MARKETS FOR U.S. TECHNOLOGY

Paris L'USINE NOUVELLE in French 18 Feb 82 p 66

[Article by Thierry Quinsat: "Sorep: Brittany-Style Silicon Valley"]

[Text] Without complications, Guy Dadou, chairman of the Sorep directorate, went to explore the small and medium-sized enterprises (PME) on the coast of California. In exchange for being introduced to French customers, two American companies will contribute their advanced technology. By 1985, 250 jobs will have been created.

"The American PME may have a little more money than we do, but they do not always have the means to locate an office, engineers, or salesmen in Europe. They are therefore interested in agreements with independent companies, of the same size as themselves, already existing on the European market."

It is with these arguments that Guy Dadou, chairman of the Sorep directorate (Rennes Company for Professional Electronics, 160 employees in Chateaubourg), straightforwardly went to prospect in the Silicon Valley. He found two customers, Apply Micro-Circuit Corporation (AMCC) and Hybrid System, with whom he has created two subsidiaries (51 percent Sorep in both cases).

In exchange for being introduced to French customers, the Americans contribute their very sophisticated technology: AMCC in the fabrication of LSI integrated circuits, and Hybrid System in the manufacture of data conversion circuits.

Between now and 1985, Guy Dadou predicts a ten-fold increase in turnover (22.3 million francs in 1981) and the hiring of 250 people. In his words, the whole thing sounds simple: "You know, the Americans said OK essentially because we were the same size as they are and because we were totally independent. In fact, I am sure that other enterprises would be ready to do the same. All you need to do is to go and see them."

But Guy Dadou is not just anybody. In the 1960's he participated in the fabrication of the first germanium transistors. He next directed a semiconductor plant, subsidiary of an Italian group, in Rennes (450 employees). And in July 1978, together with a few co-workers, he created Sorep to operate in two directions: the fabrication of hybrid circuits, and research in applications for PMI (small and

medium-sized industries). The founders brought one-third of the initial capital, the employees another third; for the rest, Guy Dadou called upon local savings: every year, about 60 people invest in the company the 5000 francs that the Monory Law allows as an income deduction.

This time, however, the increase is too large; to go from 7.37 to 13.6 million francs, the enterprise called in more conventional investors (Banexi, Institut de Participation de l'Ouest, SDR, and Banque de Bretagne), who will make it possible to invest some 80 million francs in the construction and outfitting of three new buildings, one of which will be a large testing facility.

The "new formula" circuits will enable the components sector to export 50 percent of its production, while the systems sector will produce higher performance, customized circuits.

For the internal operations of the enterprise, Guy Dadou will retain the same formula: participation of the personnel in capital, flexible schedules, open-door policy, and free-speech panels; all of these have resulted in a 4 percent absenteeism rate, despite a high proportion of female employees. Since its creation, no one has left Sorep, in spite of some dozen weddings. Invited to each one of them, Guy Dadou fully expects to invite the entire personnel to the union of Sorep and its two American partners.

11,023
CSO: 3102/190

NORSK DATA: RECORD SALES FOR NORWEGIAN FIRM

Interview With Director

Oslo POLYTEKNISK REVY in Norwegian Feb 82 pp 6-7

[Interview with Rolf Skår]

> [Text] "I am well pleased with last year," says Rolf Skår, administrative director of Norsk Data, beaming. And he has every reason to be: the total turnover went up to 475 million [kroner], 52 percent higher than in 1980. Of that amount, 245 million was in Norway, an increase of 60 percent. The incoming orders broke all records, especially foreign orders, with an increase of 58 percent. And best of all, the surplus exclusive of taxes and extraordinary items was some 40 million kroner, or 8 percent of the turnover. Unbelievably good, measured against other Norwegian industry.
>
> Everything at Norsk Data points to the economic improvement. Right in the lobby visitors are greeted with a sign showing the day's quotation on ND [Norsk Data] shares on the Oslo stock exchange (365 kroner the day I was there.) The place is seething with activity; big announcements are in preparation (see pp 7, 22 of this number). ND is not so small any longer; with a little over 1,000 employees and $100 million in turnover, it has passed the first "magic" milestones.

[Question] What pleased you most in the year just past?

[Answer] A lot of things went well last year. If I am to pick out one single thing it has to be the big NATO order we won against 35 competitors. The first contract is for 45 million kroner, but there will be more later. I regard the order as a breakthrough for us, partly because what we are to supply is right in the middle of our product spectrum.

While some of our previous big orders, such, e.g., as computers for the F-17 plane simulator, only use our machines, this NATO order will also use large

amounts of our software for administrative data processing.

[Question] How has the integration of Comtec into ND worked out?

[Answer] When I take into consideration the fact that it was our two chief competitors that were merged, I must say that it has gone unbelievably well. ND-Comtec had a turnover of 72 million [kroner] last year, mainly ND equipment, but also including a lot of Digital equipment needed by former Comtec customers. About 70 percent of the turnover represents exports.

Europe's Only 32-Bit Minicomputer

[Question] How are sales of the ND-500 going?

[Answer] After some delays we have gotten well under way. We supplied over 40 installations last year, mostly abroad. In February we are introducing a lot of innovations in the 500 family, both in hardware and in software (see the article in this issue).

[Question] Is the ND-500 still the only 32-bit mini originating in Europe?

[Answer] Yes, and there is not much to indicate that other European suppliers are planning competing offerings of their own. What most of them are doing is producing American or Japanese equipment under license.

1,000 ND-100's Delivered

[Question] How big a production capacity has ND got this year?

[Answer] We are producing in Norway, Sweden, and France, and soon will be producing in England as well. Altogether we are counting on being able to turn out 700 to 800 central units, or 3 or 4 per workday. We have recently delivered ND-100 number 1,000. It took us about 30 months to deliver those 1,000 machines; in the next 15 months we will deliver at least another 1,000. In all, a good 2,500 ND machines have been installed as of now.

[Question] Do you have any difficulties in recruiting personnel?

[Answer] It is not going so badly. Our policy is to use Norwegians in Norway, Swedes in Sweden, and so on. But we are trying to grow abroad; we shift jobs to where we have the right personnel. The primary reason for that is that we get a better position in the countries where we produce, not just sell.

[Question] Are the software revenues beginning to be considerable?

[Answer] That is really hard to measure, because the customer interest is almost entirely on the software side, but according to the price list that makes up only 15 to 20 percent of our turnover. That is somewhat more than the amount that technical maintenance brings in. But those receipts also cost: over 75 percent of our development division (about 140 persons altogether) and all of our customer support division--except for technical servicing--are occupied with software.

More Ready-Made Systems

[Question] I see it as Norsk Data's greatest weakness that you offer few ready-made systems. I believe continued growth presupposes ready-made systems; the customers will not be able to afford to develop everything themselves. Do you agree?

[Answer] Yes, even IBM has now decided to introduce a personal computer with standardized program products. We will not meet that competition, but will grow past it. A part of the market has been gobbled up and there is nothing to do about it. We have experienced this earlier: we were once dominant in the school sector, but now low-cost solutions have taken a lot of it away from us. We should not fight against them if the customers prefer standardized programs. Our main weight must be concentrated on equipment selling for over 200,000 kroner; ND's organization fits that best.

Greatest Successes Abroad

[Question] Are you planning to offer a CP/M [critical path method] mode or a UNIX [expansion unknown] mode within SINTRAN, so that ND machines can be used with standardized software products?

[Answer] The idea is very interesting, but nothing of the kind has been decided on. As a supplement we can well imagine offering software as booksellers offer books, right off the shelf, with no customer support involved. But we must not forget that the quality of the systems is an important competitive factor in the industry; good tailor-made programs will be in greater and greater demand.

[Question] Do you believe the change of government will mean less support for Norsk Data?

[Answer] The question is unimportant. We are getting most of our important contracts abroad; that is where we are doing best. The "famous" state contracts that we got so-called "help" with here at home did not bring us much joy; we have lost them all. Just think of the Telecommunications Service, the Public Health System, the universities.

[Question] But without strong state support you would surely have been out of the competition for the state insurance agency's big contract long since?

[Answer] We have not gotten that contract; all we have gotten is permission to compete.

[Question] Do you wish to say something in conclusion?

[Answer] Yes, that the most important thing that happened last year is that our stock is now listed on the London exchange. This means that we have access to international capital and the same financing that our competitors have had all the time.

New Products

Oslo POLYTEKNISK REVY in Norwegian Feb 82 pp 7, 22

[Article by Peter Hidas: "Norsk Data Gets a Face-Lift"]

[Text] ND is introducing important new products in three fields: two new models in the ND-500 series, a low-price variant of the ND-100, and improvements to NOTIS.

ND-500 Adapted to VAX Competition

From now on the ND-500 will come in three models, two new ones and the present top-of-the-line model. The three are called 520, 540, and 560 respectively. The 520 is a "cheap" model in which all the logic is assembled in one cabinet and the primary storage is limited to 2.25 MB [megabits]. Up to 48 terminals and 2.3 GB [gigabits] of storage capacity can be hooked up to the machine. For 805,000 kroner you get a minimum configuration of 750 KB [kilobits], 30 MB of magnetic tape, and a 300 KB disk station.

The 540 is about twice as fast as the 520, thanks to a 32 KB storage unit, but a corresponding configuration costs only 1,005,000 kroner. A 520 can easily be upgraded to a 540 on the spot.

The 560 is the big brother that can be expanded all the way to 32 MB primary storage--at least in theory. But it is not hard to reach 7.25 MB. A 560 can be controlled directly from 64 terminals. A practical minimum layout--without peripheral equipment but including some tape capacity--costs 1.2 to 1.3 million kroner.

In comparison to the other 32-bit superminimachines the ND-500 is very competitive in price and performance. Part of the secret lies in a new "multiport memory system," which makes possible more than one access to the primary storage at the same time. The problem lies more on the software side, which is not much developed as yet--but there, too, ND has made considerable advances. The software has been made more efficient, especially for multiple-user situations. All in all, a good face-lift, which was absolutely required in the competition with Digital's three VAX machines. 1981 was a VAX year in Norway; will 1982 be an ND-500 year?

Little Brother in the ND-100 Family

The other big new item is little: two new baby models in the ND-100 series. Among the initiate they have long been known under the code name "Pinnocchio"; we discussed them last November in the POLYTEKNISK REVY.

The official name is ND-Satellite. The machine looks about like a refrigerator in one of the better international hotel rooms: a box on wheels, half a meter high and 60 cm wide and deep, which weighs 75 kg and develops 500 W of heat. It is designed with an eye to the office environment: little noise and relatively modest heat generation. It can, e.g., stand under a desk.

The "refrigerator" contains no quart bottles of champagne, but an ND-100 central unit consisting of a circuit-board, primary storage, a Winchester disk, a 1.2 MB disk station, and other necessary equipment.

The Satellite is available in two variants: Model 5 with 256 KB, 13.8 MB Winchester, and the possibility of connecting 5 terminals, and Model 9 with 512 KB, 21.9 MB tape, and up to 9 terminals. The terminals can be Tandberg screens and several different recording devices: Diablo writer, Tally needle writer, Epson MX-80, or Terminet 340.

The Satellite is supplied with standard ND software: SINTRAN III/VS, NOTIS-WP, programming languages, communication procedures, etc.

The prices are interesting. A Satellite/5 box with all its contents, but without terminals, costs 170,000. This includes SINTRAN, NOTIS-WP, and a lot of basic software. With 4 Tandberg screens and a Diablo writer the price goes up to 263,000 kroner, *or 60,000 kroner per operator's position with screen.* The price per screen, in other words, is on a par with a single-operator position with micromachine.

The price picture is still more favorable for Satellite/9. The "box" costs 240,000 kroner; with 8 screens and a writer the total price is 395,000 kroner, *or under 50,000 kroner per operator's position with screen.*

The primary target group for Satellite is the present ND-100 users in administration, offices, industry, and the school system. With Satellite, ND can compete for distributed systems in the 200,000 to 400,000 kroner price class, i.e. in a field that has been closed to the ND-100 up to now.

Improved NOTIS

NOTIS is the ND-100's word-processing package, used by most of the larger ND-100 customers. Now the "package" has been redefined, and includes three different but interrelated components.

The first component is NOTIS itself, which from now on is called NOTIS-WP, and which has become more streamlined than before. And a good thing, too, for the old NOTIS was somewhat heavy and clumsy.

The second component has been known up to now as GRAFS, an unattractive name that was easy to remember. From now on the child will be called NOTIS-IR for information retrieval. It is a system for full-text search, intended for document collections, legal codes, regulations, archives, and the like. When you do not know the file number of a document you can find it by supplying some characteristic key word that occurs in the text.

The third NOTIS component is ACCESS, a system for quick reference to files. The files look like tables, and with ACCESS they can be defined, brought to light, searched through, and printed out in whole or in part. ACCESS is very reminiscent of IBM's SQL and Query by Example. The first model of ACCESS works in a relatively limited way, but the basic concept is good and promising.

8815
CSO: 3102/227

NORSK DATA INTRODUCES FIVE NEW COMPUTER MODELS

Aimed at West European Market

Paris ZERO UN INFORMATIQUE HEBDO in French 15 Feb 82 p 1

[Text] All is not glumness in data processing, and the minicomputer sector (especially its 32-bit top-of-the-line quadrant) continues to expand. The Norwegian manufacturing firm Norsk Data has recently chosen London in which to underscore its European orientation, highlight its successes, and introduce five new models.

Norsk Data in 1981 had total sales of 475 million Norwegian kroner (the krone is currently worth around 1 French franc), up more than 50 percent over the preceding year. The Norwegian firm exports around half its production. Until now the Oslo-based firm has centered its sales effort essentially on the final user market (the European Nuclear Research Center at Geneva is one of its best-known customers), but hopes now to increase its cooperation with the services-marketing and systems-marketing companies so as to expand its OEM [original expansion manufacturer?] sales.

It is with this in mind that the firm has introduced two new bottom-of-the-line (16-bit) models: The Satellite 5 and Satellite 9, which are actually "packaged" versions of the ND-100.

At the top of the line, its ND-500 (32 bits), renamed the ND-540, has spawned the ND-520 and ND-560. All of this hardware is geared to the Sintran III/VS multimode, multi-user system of operation.

According to the Norwegian builder, these models are comparable in power to the Prime 850 and to Digital Equipment's most recent VAX 11/782 biprocessor.

New Models Described

Paris ZERO UN INFORMATIQUE HEBDO in French 15 Feb 82 p 3

[Article by Gerard Schmitt]

[Text] In an effort to enlarge its European market, Norsk Data last week chose the British capital in which to announce the latest additions to its

product line. Its catalog has been re-edited and enlarged to include five new computers based on the design and the technology of the older members of their family, the ND-100 and ND-500.

The new additions include, at the lower end of the line, two 16-bit machines--the Satellite 5 and Satellite 9--which are "packaged" versions of the ND-100, the prices of which appear to be around 50 percent lower than those of their nearest competitors.

At the top of the line, the ND-500, renamed ND-540, has sired two other 32-bit models: the 520 "bridled" version, and the 560 "muscled" version, the latter offering, according to the Norwegian builder, performance characteristics better by 50 percent than those of the Vax-11/780 at a nearly equal price.

The line now includes, therefore, listed by order of power, the Satellite 5, Satellite 9, ND-100, ND-100CE, ND-520, ND-540 and ND-560.

A noteworthy feature is that all these models operate on the same Sintran III/VS multimode, multi-user system and its subsystems, and accept Basic, Cobol 74, Fortran 77 and Pascal languages.

Distributed Networks

The Satellite 5 and Satellite 9, whose appellations indicate they are primarily designed for integration into distributed networks, are in effect ND-100 "packages" accommodating respectively 5 and 9 peripherals (screen and keyboard, or printer). The first has a 256K central memory, a 1.2M floppy disk drive, and a 13M Winchester disk.

The second has a main memory capacity of 512K and a 21M Winchester disk. Both models are equipped with either one or two HDLC [high-level data link control] lines and will, as a standard feature, accept--besides the basic version of the Sintran operating system--Notis-WP word processing software.

Available options include accessory gear of various kinds, enabling the remote entry of data or programs, accessing and updating data bases, the design and testing of scientific or management programs, etc.

The price of the basic configuration is around 240,000 French francs for the Satellite 9 and 161,000 French francs for the Satellite 5; the latter model, with four screen and daisy-wheel printer terminals is offered at around 260,000 French francs.

As for the three top-of-the-line systems sired by the ND-500, their architecture is the same as that of the latter.

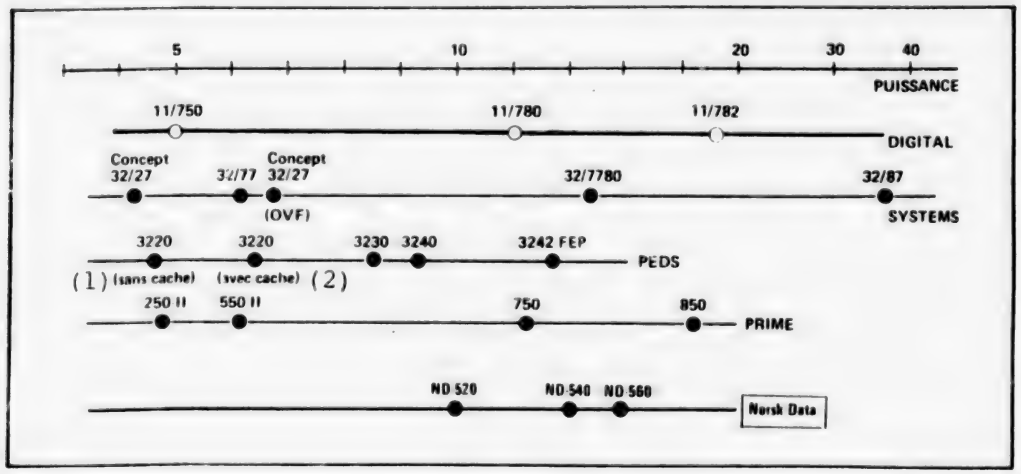
Quick Calculations

Each of them has two processors: one ND-100 which handles the input/output operations, the task programing function, and the allocation of system resources; the

Norsk Data	1981	1980	1979	1978	1977	1976
Total sales (in MCN [million Norwegian kroner])*	475	313	215	161.6	111.9	80.7
Exports (percentage of total)	50	49	46	36	46	42
Net profit before taxes (in MCN)*	40	28.1	12.8	10.9	7.3	4
Profit margin (percent)	8.2	9	6	6.8	6.5	5

(Source: Norsk Data)

* 1 Norwegian krone = 1 French franc approximately



Key:

1. With storage and retrieval.

2. Without storage and retrieval.

second processor, an ND-500, is dedicated almost exclusively to calculations. It is recalled here that the general characteristics (memory management system, instruction set, etc) of this machine were discussed in ZERO UN INFORMATIQUE HEBDO No 538).

With performance figures around 0.9 MIPS [million instructions per second], the Model 520 rates as a "bridled" version of the 540 (formerly ND-500). With a 0.75M memory, expandable to 2.25 M, it is housed in a single cabinet. Its price in the basic version, is 800,000 French francs (overall).

Model 540 differs from the foregoing essentially in that it is equipped with a 32K storage and retrieval memory. Its power is then 1.9 times that of the 520.

In its basic version, it lists for 1 million French francs.

Lastly, Model 560, with performance ratings (1.75 MIPS) similar to those of the 540, can accept from 512K to 32M of memory and use a storage and retrieval memory expandable to 128K. It can take up to 64 terminals.

Its base price is 1.2 million French francs.

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MATRA HARRIS SAMPLES FASTEST 16 KBIT C-MOS RAM IN WORLD

Paris ELECTRONIQUE ACTUALITES in French 19 Feb 82 pp 1, 10

[Article by J.-P. Della Mussia: "A French First in Memory Technology"]

[Text] A world premiere is taking place at MHS [MATRA [Mechanics, Aviation and Traction Company] Harris]. This firm is currently sampling a C-MOS [complementary metal oxide semiconductor] 16-Kbit (2K x 8) RAM [random access memory] that features the best speed/energy consumption compromise available on the market, with an access time of 55 ns [nanoseconds] (max) and a power requirement of not more than 0.1 mA [milliampere] at rest. By comparison, the fastest 16-Kbit C-MOS available until now has been that of a small American firm, IDT's 6116 (90ns) followed by Hitachi's HM 6116 LP (150 ns).

This disclosure coincides with four other major events at MHS: A rise in mass production of its C-MOS 4-Kbit RAM's (1 million chips had been produced as of October 1981; 2 million had come of the production lines by mid-December); the putting into production of an improved SAJI IV technology in the chip component thickness range below 2.5 microns (approaching the H-MOS II) that improves the performance of memories while lowering their cost; the bringing out of MHS's first N-MOS [n-channel MOS] circuits (the 8048); and the creation of a joint marketing network with Harris in Europe. MHS thus finds itself well armed to resume the C-MOS offensive in the face of the current Japanese attack. This is all the more so since the French company has available to it the Harris sales network in the United States, for its innovative products as well as for circuits produced jointly with its American partner owing to much lower production costs in France. These American and European marketing networks will also be open to MHS's future N-MOS products.

Only Static Memories

The launching of MHS's C-MOS 16-Kbit fast RAM is important from several standpoints. Being the first company to introduce such a product, MHS will be able to sell it at a price reflecting the industrial reality at MHS and not at a virtually imposed Japanese price that in general does not enable Western companies, in times of crisis, to realize a profit, even considering only their marginal costs. It also proves that MHS has a good technological capability that should enable it to

innovate, from the hardware standpoint, with respect to other circuitry. And thirdly, MHS has been using this technology since the end of December for its 4-Kbit memories, a change that should enable it, in the very future, to more than double its number of good chips per production run, and hence to compete on equal terms with the Japanese companies on circuits that will be at the very top of their product lines for 1 or 2 more years to come yet.

The advent of this memory is also important to users, who are constantly after the fastest possible circuits for their microsystems. The fact is the market currently offers only either pure C-MOS memories with at-rest power requirements of the order of 10 microamperes but slow (MBB 417: 200 ns; TC 5516 AP: 250 ns), or rather fast pure N-MOS memories with at-rest power requirements exceeding 10 milliamperes (M 58725: 150 ns; MK 4802-70: 70 ns; 21881: 65 ns). MHS's HM 65161 memory uses, in its chip, an N-MOS core (memory cells consisting of 4 transistors + 2 high resistances) and C-MOS peripheral circuits, providing, in principle, a good chip speed/power requirement/surface area compromise as compared with the two other formulas. This solution was first proposed by Hitachi 2 years ago. MHS's memory is simply an improvement in the speed of that memory, the improvement being such as to even beat the speed of the pure N-MOS models. The 65161 is entirely static and is of the asynchronous type, unlike another model, the 6516, which is synchronous; the latter is currently being sampled by Harris and will be produced by MHS at Nantes in December 1982. MHS has adopted an asynchronous formula because at least 80 percent of the market currently demands this type to augment system speeds. Current static N-MOS memories are moreover of the asynchronous type.

MHS is also studying a model configured around 16K x 1 and another around 4K x 4, which will be introduced in September and December respectively. The French company will also sample in April a 1-Kbit C-MOS memory (the 6561) configured as a 256 x 4 for use in T 83 telephones.

Still within the static RAM domain, MHS has been sampling since January a 64-Kbit (8K x 8) C-MOS hybrid model, whose 4-Kbit chips are mounted on a chip carrier at Nantes and whose mounting on a ceramic substrate is done in Malaysia.

Sampling of 80C48 Could Start in April

The technology developed for memories will of course be used by MHS for the company's other circuits, and especially its C-MOS microprocessors and their peripheral circuits. MHS is currently testing the first chips of the C-MOS version of the 8048 microprocessor which the company itself developed. If these tests prove satisfactory, the sampling could start in April (otherwise, their introduction will be delayed at least 3 months).

Concurrently, Harris in the United States is honing the C-MOS version of the 8086 for sampling, which is scheduled to begin in June, to be followed by production by the end of 1982. A series of C-MOS peripheral circuits will also be offered at that time (82C43, 82C55, 82C53, 80C88, 80C51), of which the 80C51 is being developed by Intel and will be produced under license by MHS.

MHS is moreover studying the possibility of manufacturing a C-MOS microcomputer under license and in versions designed for certain types of applications (automobiles, electric household appliances, toys, telecommunications). The company is currently investing heavily in this regard to become independent with respect to computer-assisted design and to software. (A software antenna is in the process of being installed in California).

Lastly, we recall that the sampling of a purely MHS C-MOS COFIDEC [expansion unknown] is planned for the end of 1982.

The 8048 in Production

With regard to the N-MOS circuits it manufactures under Intel license, MHS has a program for the sale of these circuits, primarily as components of kits, but above all a program for manufacturing directly from Intel masks. The first circuit manufactured (with good yields from the very first run) was the 8048. The 8048 and the 8051 will thus be exhibited at the Components Show. They will be followed in the second quarter by the 8086, and in the third quarter by the 8088.

In the bipolar sector, on the other hand, MHS has deferred its investments by 1 year so as not to spread its efforts too widely.

A Harris-MHS Sales Network in Europe

The joint Harris-MHS sales network in Europe will carry the name "Harris MHS" (see ELECTRONIQUE ACTUALITES of 15 January 1982).

Initially, the efforts of its management staff will be centered on increasing the group's direct sales: Harris presently generates 70 percent of its total annual sales in Europe via distributor channels and 30 percent directly, a ratio that is exactly the inverse of normal (30 percent via distributor channels, 70 percent directly). The reversal of the current situation should also have the effect of increasing Harris's exports to our own continent, which presently total $25 million annually, or 20 percent of its total annual sales.

Memories With Redundancy: Not Always Viable

MHS will adopt redundancy for its 16K x 1 static RAM's, but not for its 2K x 8 memories. Redundancy actually entails an increase in chip surface area and a loss of speed which vary according to the memory's configuration.

For a 2K x 8 chip, in the case of one flaw, a built-in redundancy stack must be used and one point in eight of the stack must be matched to the fault. This entails a loss of 5 to 7 ns, or 10-15 percent, of access time, which is substantial. Redundancy is therefore not viable unless there are many flaws, and production run yields must be increased.

For a 16K x 1 memory, on the other hand, multiplexing among bits in the redundancy stack is not necessary and the loss in access time owing to redundancy is of an order no greater than 1 nanosecond. Moreover, the increase of chip surface area does not exceed 2 percent. In this case, therefore, redundancy is unquestionably an enhancing factor.

9338
CSO: 3102/168

ELECTRONICS

FIVE-YEAR PLAN ANNOUNCED TO AID ELECTRONICS INDUSTRY

Paris LE MATIN in French 12 Mar 82 p 5

[Article by Christian Menanteau]

[Text] The government's objective: rebalance this sector's deficit in 1986. A strategic branch if there ever was one, the French electronics industry is being treated with solicitude: beginning this year, the government will put 480 million francs in the public assistance pool for research and development in this sector. This is a prelude to a five-year plan (1982-1986) announced Wednesday by the Council of Ministers: a little boost, which was essential in view of this sector's deficit of 600 million francs last year. The avowed goal of the government is to achieve a trade balance in the microelectronics field before 1986.

Faced with a very scattered industry, where several public companies are competing for portions of the market as well as to avoid the piecemeal erosion of their prerogatives, the government is still finding its way. The French electronic industry, confronted with the American and Japanese challenge, is indeed in disarray: Thomson feudalized, CII-HB faced with delicate deadline problems, and Matra which plays on the various existing trends in order to get its share. Since 1977, the year of the first five-year plan, the administration has been hesitant about major options. At that time, the government had launched a first French components plan hinged around five points: three existing enterprises (a joint subsidiary of Thomson-CSF and the Atomic Energy Commission, Thomson-CSF, and Compelec, a subsidiary of the Dutch company, Philips), and two newly created ones (Eurotechnique, born from the union of Saint-Gobain and National Semiconductor, and Matra-Harris). The government's investment amounted to 742 million francs.

Pierre Dreyfus' proposals are also aimed at increasing the national potential and at infusing integrated circuits within the industrial body. This, as well as the introduction of electronic components in automobiles, the audiovisual sector, games, and so on. The proposals cover two phases: beginning in 1982, 480 million francs will be distributed among five ministries, with industry and defense receiving the lion's share of 230 and 100 million respectively. The avowed goals being the development of integrated circuits, notably silicon and gallium arsenide, machines, bubble memories, and low temperature circuits. In addition, a privileged financing

purse is open for projects that do not fall within this plan; it should amount to 340 million francs. The second phase, still not fully defined, covers the 1983-1986 period. Under the promising title "Development Plan for the Components Industry," an interministry group for integrated circuits, GICI, will release its conclusions in July.

According to experts in the Ministry of Industry, the worth of the French microelectronic industries is estimated to be 2.2 billion francs in investments, and 3.4 billion for research and development in the next five years. These sums represent a two-fold increase in the effort that has been made so far, but the powerful interests involved, and especially the fact that these sectors are among the rare profitable fields in the world, demand a most rapid definition of a true comprehensive strategy on the part of the French electronic industry.

11,023
CSO: 3102/190

FRANCE'S POSITION IN WORLD ROBOT MARKET SKETCHED

Paris AFP SCIENCES in French 11 Feb 82 pp 21-22

[Unsigned article]

[Text] Paris--Industrial robots are 20 years old in the United States. In France, their development came much later and the market remains poorly developed, with a limited number of manufacturers: today, one out of two robots comes from abroad.

Credit Commercial de France (CCF) is preparing a study of about 100 pages on industrial robots, whose sales have soared in the last 10 years. The study first examines their place in automation, then considers their development and their market.

This is a strongly growing market (+ 30 percent per year), where the first manufacturers were the Americans but where once again Japan pioneered, stimulated by its automobile industry. Thus from 1977 to 1979, Japanese demand was twice that of the United States.

Through the years, the United States made up for this lag since its demand has come much closer to Japan's (130 million dollars compared to 175 million in 1981). These figures do not begin to match projections for the 1990's: American demand is estimated at between 800 million and 2 billion dollars and Japan's at 1.15 billion.

Europe looks like a stepchild with the exception of Sweden, which now has the highest number of robots per capita. It was the first European country to adopt this technology, so as to maintain its productivity in an industry where manpower costs were extremely high. According to CCF, this trend was also encouraged by unions which saw it as a means for eliminating monotonous or undesirable jobs.

Other European markets have developed more recently, later than in Japan and the United States. The first market to grow was in Germany, followed by Italy and France, with a small British market in last place.

Therefore it is not surprising to find three Swedish enterprises among Europe's seven major suppliers. However, it is an American Enterprise, Unimation, which leads the old continent with 23 percent of the European market, followed by a Norwegian company (Trallfa with 17 percent of the market), with the three Swedish concerns coming next.

French domestic demand remains small (100 million francs in 1980). For top and middle of the line, the market was strongly affected by the appearance of Renault in the mid-70's, when this company devoted considerable amounts of money (15 million dollars according to CCF) and five years of effort to the field.

In fact Renault is the only French manufacturer offering a complete line of robots, and the only one with intelligent robots. It is in a position to export to the United States and Asia. By around 1983 it should become one of the world's major producers with 650 units (compared to 150 in 1981).

Far behind Renault is their sole French competitor, the former production workers' cooperative, AOIP. While it produced only 15 robots in 1980, AOIP reached a production of about 40 last year, and its robot turnover should amount to 100 million francs by 1983-84.

In the future, the French picture for top and middle of the line could be modified by the appearance of new manufacturers -- there is talk of Manuhrin, a Matra subsidiary -- without being radically affected.

11,023
CSO: 3102/194

INTERNATIONAL PARTNERSHIPS FORMED FOR R&D IN ROBOTICS

Paris ELECTRONIQUE ACTUALITES in French 19 Feb 82 pp 1,3

[Article by G. Bidal: "Robotics at Stage of Developing Major International Alliances"]

[Text] The last several months have seen a mushrooming of cooperation and licensing agreements in the domain of robotics, principally among Japanese and European builders. France, however, has remained dangerously out of it all. If this gap is to be closed in a domain in which our country cannot afford the luxury of playing the game alone, some cooperation agreements will have to be signed within the next few months.

Robotics market studies are proliferating without any noticeable betterment, however, in their reliability. The most recently dated one by the CCF [Credit Commercial de France] has the merit of having relativized the figures it adduces: It puts Japanese demand at $175 million in 1982, that of the United States at $130 million, and that of the European market approaching $100 million. These figures can be taken as a basis for further study. But beyond that, everything boils down to pure conjecture in view of the newness of a market whose growth will depend largely on the success of the research currently under way. Based on the CCF study, an order of magnitude of $1 billion may be assumed for each of the three mentioned markets--the Japanese, the European and the American.

One certainty is that the market exists and that its growth rate today exceeds 30 percent. Besides, the time is not one for arguing over figures but rather one for defining strategies. During the last few months, the robotics industry has entered into its structuring phase. New partnerships, like those already in place between Fujitsu-Fanuc and Siemens, and between Kawasaki and the American firm Unimation, have come into being under the form of marketing agreements providing generally for the granting of manufacturing rights and for joint developmental efforts: Kobe Steel with the Norwegian company Trallfa, the world's leader in painting robots; Daido with the American company Prab-Versatran; Dainichi Kiko with the British firm Sykes; General Electric with Hitachi and the Italian firm DEA [Digital Electronic Automation]; Westinghouse with Olivetti's robotics subsidiary OSAI [Olivetti Systems for Industrial Automatization]; Fanuc with General Motors and the British "600 Group"; Nachi-Fujikoski with the German firm Kuka; United Technologies with the German firm Nimak; Murata with Prab-Versatran; Mitsubishi with the Austrian firm Voest-Alpine.

This list is not exhaustive and should lengthen considerably over the next few months: The Swedish firm ASEA [Swedish General Electric Corporation], a European leader, could join up with the Japanese firm Yaskawa; the British group GEC [General Electric Company, Lts.] and its subsidiary Hall Automation are putting into place an ambitious investment plan that is to involve technical and commercial agreements with the Japanese firms Hitachi and Yaskawa.

Rarely has a budding market given rise so rapidly to such a worldwide interleaving of industrial interests. This can be attributed to several reasons. To begin with, the robotics industry is by its very origin linked, from the supply as well as the demand standpoints, to the using industries, principally the automobile, electrical equipment and machine tool industries. The fact that it includes such firms as Kawasaki, Mitsubishi, Hitachi, Toshiba and NEC in Japan, ASEA, Electrolux, Volskwagen and Renault in Europe, and Cincinnati-Milacron-General and General Electric in the United States illustrates this point. An infinitesimally small number of firms are dedicated exclusively to robotics; in this regard, Unimation, although the world leader, is the exception. The foreseeable entry of groups such as IBM, Texas Instruments or Hewlett Packard from the electronics industry into this market, rendered probable by the growing importance of data processing and software to robots, will in no way change this fact. Short of confining their activity solely to the electronics market--a limited one if one considers the size of these firms--there can be no doubt that their strategies will also involve alliances with the machine builders.

Another factor lending support to the development of these many alliances is that robotics is a guzzler of research and development funds. Renault invested some $15 million over a period of 5 years before producing its first robot. Despite its strategic aspect, however, the robotics market is small when compared to equipment-making industries as a whole (it could represent at most a small percent of the total machine-tools market, for example). Although its profitability is an established fact from the standpoint of the user, this is not so from that of the supplier: The fact is that only a very small number of builders have reached a point of profitability which nevertheless remains a very fragile one. As a consequence a state of relatively specialization is developing among the manufacturers (spot welding, arc welding, painting, assembling, etc). And since the multiform aspect of robotics requires at the same time the coverage of a very broad technological field, cooperation becomes a quasi-compulsory route.

This is further abetted by the fact that robots do not take very well to being marketed by simple distributional methods and, generally speaking, agitate for close-knit marketing alliances. Therein lies undoubtedly the explanation of the feeble Japanese penetration into Europe and, at the same time, of the important position occupied by the Japanese builders in the network of worldwide alliances now being put in place. The stagnant state of Unimation's robot sales in Europe, where it markets its robots only through small-distributor channels, also finds its explanation undoubtedly therein.

Is France Out of It?

This being the situation, one cannot possibly avoid a feeling of uneasiness at seeing the French builders occupying spectators' benches with respect to the vast network of worldwide alliances being put in place. There are of course some very notable exceptions, such as Renault and its American subsidiary jointly owned with Ransburg (Cybotech), and Sciaky, which is entering the American market by way of its alliance with the Alleghany Company. But at a time when the big foreign groups are maneuvering their playing pieces, we in France seem to be more occupied with examining detailed market studies in search of a supposed financially miraculous niche. Obviously, the slackness of the French market, which did not reach 200 million francs in 1981 and 50 percent of which was covered by imports, is anything but an excuse. Let us be fair: Several of our builders have been trying for some time to acquire an international dimension. An agreement is in the process of negotiation between Mitsubishi and Sciaky, which builds welding robots. In the same domain, Commercy Soudure is seeking to enlarge its distributorship agreement with Shin Meiva of Japan through a technical agreement. Mitsui is in contact with CGEE [General Electrical Equipment Company]-Alsthom. As for AOIP [Precision Instruments Workers Association], the second-ranking French builder, the major portion of whose total annual turnover already comes from foreign sales, should within the next few months be disclosing technical and marketing agreements with foreign partners. This is not to mention possible newcomers, among whom the name Manurhin (MATRA [Mechanics, Aviation and Traction Company]) keeps cropping up. But time is passing and the essential task of the Robotics Mission headed by Mr Petiteau should be to define the conditions of the insertion of the French robotics industry into this new worldwide network. That Mission will be submitting its findings in April.

9238
CSO: 3102/169

NATIONAL INDUSTRIAL ROBOTICS PLAN PROPOSED

Paris ELECTRONIQUE ACTUALITES in French 12 Mar 82 pp 1,3

[Article by G. B.: "For a National Robotics Undertaking"]

[Text] By way of a report devoted to the use of robotics in production, the CES [Economic and Social Advisory Board] has called for the setting up of a full-scale plan by the government putting in place a French "robotics undertaking." Noteworthy among the measures advocated is that of a restructuring of this industry around some of the "largest firms."

This report, called the Lasfargue Report (after its drafter and rapporteur), and calling for a vast government plan in the field of robotics that would involve a restructuring of this industry by the government, has just been approved quasi-unanimously by the members of the CES including, it should be noted, those representing private industry.

The French Lag

Addressing robotics within the general context of automation, in which it is but one link in the chain, the report sets forth France's "considerable lag," attributing it to "a technological and economic laissez-faire" that has led French industry to import over 60 percent of the robots it uses. The study points out that the French numerically-controlled machine tool population reached a total of 10,500 units at the end of 1980, versus 70,000 for the United States, 50,000 for Japan, 25,000 for the FRG, and 20,000 for Italy.

The French robot population, based on a very broad definition of robots, was 38,000 units at the beginning of 1982, with an installed value of 1.6 billion francs. Of this number, 635 robots in the strict sense of the term (fully programable equipment on more than 4 axes) are currently in use. Thus, with 0.8 robot per 10,000 industrial workers, our country ranks 6th worldwide, well behind Sweden (8 robots per 10,000 workers), Japan (6) and the United States (1.6). The French market in 1981 was 150 to 200 million francs depending upon whether those built by the AEC [Atomic Energy Commission] and Renault (for their own use) are counted. Although this market represented only 0.28 percent of the total automation market in 1980, it should grow at an annual rate of 30 to 50 percent over the next 10 years.

The report is severely critical of the government's performance up to last year, deeming its action late and the level of its planned investment in robotics too low as compared with the total of its investments in automation. The "billion for robotics" in the form of bank credits (the state having supplied 70 million francs in aid) had been spent by March 1981 and had been only partly allocated to equipment directly connected with robotics. According to the CES report, the government's action in fact amounted essentially to boosting the demand, which in turn produced a sharp acceleration of imports. On the other hand, the policy of "pilot projects backed by the CODIS [Committee for the Development of Strategic Industries] increased the French supply imbalance by favoring the most sophisticated equipment but the least suited to the basic needs of the market."

While the CES report cites as a reference the "machine-tool plan" put in place by the government, it recommends a more specific intervention by the state in the robotics domain. It recommends that this intervention "take more into account the diverse aspects of robotics and avoid assigning to the same policy and administrative structures (Ministries of Research and Industry) the function of mounting a new industrial undertaking.

For a Restructuring

A policy centered solely on demand should be replaced by a "policy of utilization" that brings together the using industries, the builders, the government, and all the social partners to formulate with precision the needs in robots and the conditions that are to govern their use (human aspects, impact on employment and skills, retraining).

What the report advocates, finding that French production has many lacunae from the standpoint of self-sufficiency, particularly in the basic components sector, is the putting in place of a complete--from components to consultative assistance to installation--"robotics industrial chain."

To set up this chain, a robotics plan identical to and supplementing the machine-tool plan should, according to the report, be rapidly put in place. The CES deems it necessary to restructure the supply end of the chain, facilitating, for example, a regrouping of the marketing activities of the small builders of small manipulators. Considering the extent of the facilities owned by the state, procured through expansion of the public sector, the robotics industry, widely dispersed at present, should, according to the report, "be structured around a few of the largest enterprises." The CES adds that the government should develop the Renault group's subsidiary ACMA [expansion unknown], enlarging the scope of its activities, currently too oriented towards the automobile industry, to include all industry.

9399
CSO: 3102/210

BRIEFS

CITROEN FLEXIBLE WORKSHOP--The Citroen flexible workshop yields a productivity (evaluated by simulation) 5.8 times that of a traditional workshop of the same capacity. This gain in productivity is accompanied by gains in performance in other domains: Fabrication time reduced from 37 days to 3; production financing costs reduced fourfold; recovery of investment 3.1 years versus 4.8; internal utilization factor over a period of 5 years 32 percent versus 2; actualized real profits from the 4th year in lieu of the 8th. From the technical standpoint, the workshop, which is equipped with machining centers, is operated in real time. It can work 24 hours a day and its central computer takes over the automatic operation of parts pallets, tools, a measuring machine, and numeric-control programs. Operational control of tools starts from a central 600-tool shop from which tooling measurements are transmitted to the central computer for automatic correction. The numeric-control programs are transferred by remote loading to the various machines. The flexibility of this workshop is such that any piece that can be inscribed in a cube measuring 500 mm per edge can be machined automatically. Reader service code 0620. [Text] [Paris MACHINE MODERNE in French Mar 82 p 61] 9399

CSO: 3102/210

SCIENCE POLICY

FINANCIAL MEASURES PROMOTE INNOVATION IN BUSINESSES

Paris AFP SCIENCES in French 11 Feb 82 pp 1-3

[Unsigned article]

[Text] Paris--Several measures for financing innovation in enterprises were announced on 4 February by Jean-Pierre Chevenement, minister of research, in an address to a session of INODEV (a mutual security society for the development of innovation).

These measures, jointly prepared by the Ministry of Research and the Ministry of Economy and Finance, affect "intermediate-term innovation loans" (MTI), participatory loans, and long-term loans. For the first two of these categories, credits and loans extended by banks are secured by INODEV, relieving the bankers of attendant risks after study and approval of applications. INODEV has thus provided backing to nearly 400 enterprises (40 percent of which were less than one year old), for about 260 million francs since the society was established in 1978.

The minister announced that MTI, whose rates were variable until now depending on the bank and enterprise involved, will henceforth be "granted at a stated set rate, corresponding to the most favorable rate prevailing on the market", which currently is 15.5 percent including all commissions.

At the same time these credits will now be extended without any requirement of financial guarantees, including personal guarantees, regardless of what the conditions may have been until now. Finally, their borrowing limit will go from 75 percent to 100 percent.

In addition, Mr Chevenement specified, ministry departments and regional public organs are authorized to extend these credits with "sector bonuses" or "regional bonuses", when the proposed innovation is in keeping with their priorities.

Government endowment of participatory loan guarantee funds has tripled in one year, and 55 percent of these funds will now be virtually automatically committed as soon as INODEV agrees to shoulder 20 percent of the risk. At the same time, INODEV will be able to increase its part to 30 percent for the most interesting applications, thus reducing bankers' risks to 15 percent.

Finally, Mr Chevenement declared, the state has decided to reserve one billion francs for long-term financing of innovation "at an extremely discounted rate" which is expected to be of the order of 13.5 percent and which will soon be announced more specifically by Mr Delors, minister of economy and finance. These credits will be allocated by specialized establishments "under the technical supervision of the Ministry of Research, and under joint conditions with intermediate-term credit currently under study."

INODEV's capital has tripled from 500,000 to 1,500,000 F. Mr Chevenement expressed the wish to see it extended to the financial community as a whole.

While retaining its acronym, INODEV will become "The Institute for the Development and Financing of Innovation", a powerful instrument together with ANVAR (National Agency for Valorization of Research), which subsidizes the research preliminary to these innovations.

For Mr Chevenement, the development of innovation, "the best and in fact the only chance of survival for PME/PMI" (small and medium size enterprises and industries), is "an inevitable phenomenon." He stated that "Japan expects that within five years, 35 percent of the industrial turnover will consist of products which do not exist today."

INODEV is presided by Roger Pujol (president of the PME equipment credit board). Vice president is Thierry Gaudin (Ministry of Research and Technology, while Bernard Daude is director general.

INTERMEDIATE TERM INNOVATION (MTI) -- NEW SYSTEM

Beneficiaries: all enterprises operating in France.
Scope: all financial requirements of an innovation program.
Duration: 2 to 10 years.

	Before 4 February 1982	After 4 February 1982
For Enterprises		
Cost	Bank intervention cost (variable by bank and enterprise), + cost of INODEV and CEPME commissions (1.25 %)	Stated set rate: basic bank rate + 1.50 % For a final cost of 15.50% on 4 February 1982 Regardless of duration Whether credit is convertible or not.
INODEV guarantee fund subscription	3% of credit amount, 2% of which is refundable on completion of operation	Eliminated
Participation in INODEV capital	---	0.1% of total credit used

Real or personal guarantees	Eventually required	Excluded
Market studies	---	Possible
For Banks		
Bank risks	0%	0%
CEPME borrowing limit	75%	100%
Conversion	Possible, according to Banque de France regulations	Possible, according to Banque de France regulations

11,023
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SCIENCE POLICY

BRIEFS

NATIONAL RESEARCH, TECHNOLOGY AGENCY--In its communique of 11 February, the Ministry of Research announced that Jean-Pierre Chevenement, minister of research, has appointed a study committee to specify the role and tasks of a future National Agency for Research and Technology. The communique specified that the main objective of this agency will be to federate the regional associations for research and technology which encompass researchers and members of "the nation's lifeblood," as a sequel to regional meetings which laid the groundwork for "the national symposium of research and technology," held last month, and designed to "implement the results and follow up the proposals" of the symposium. The agency will work in close collaboration with CESTA (Center for the Study of Advanced Systems and Technologies), an agency currently under study and which should become operational by the third quarter of this year. The study committee responsible for planning the National Agency for Research and Technology is composed of about twelve personalities who participated in the national symposium; its honorary president is Francois Gros, scientific advisor to the Prime Minister, and the president is Michel Callon, director of research at the Ecole des Mines and joint coordinator of the national symposium. Mr Callon will present a report to the minister of research before 31 March, the communique concludes. [Text] [Paris AFP SCIENCES in French 11 Feb 82 pp 8-9] 11,023

TECHNOLOGY TRANSFER PROCEDURE--The government has decided to institute a national control procedure on technology transfers to foreign countries and particularly to the Eastern countries. This decision has just been announced to the diplomatic press by the minister of defense, Mr Hernu. A commission under the oversight of the prime minister, with the participation of the Ministries of Foreign Affairs and Defense, will be charged with "the protection of sensitive French technologies having possible military fallout." This commission will not take the place of the control exercised by the COCOM [expansion unknown], in which France will continue to participate. [Text] [Paris ELECTRONIQUE ACTUALITES in French 19 Feb 82 p 2] 9238

SCIENTIFIC COOPERATION WITH AFRICA--Nice--"The new scientific cooperation policy between France and the African nations will rely not on transfer, but on technologic co-development, as defined by the Lagos Action Plan," declared Jean-Pierre Cot on 28 January, in Nice. The minister of cooperation and development, closing a meeting of representatives from 20 African nations, stated: "The Nice-Lagos Manifesto relies on the observation that the economic crisis of the developed nations, and that of developing ones, are two aspects of one and the same crisis." France will therefore use "self-centered" development strategies, aimed at encouraging renewal while reducing dependency. One of the participants in fact pointed out that the traditional technologic transfer policies amount to a decision that poor countries must purely and simply import the technologies of rich countries, whereas the modes of development are different. The Nice Manifesto, formulated after a three-day meeting, thus recommends the "legitimization and popularization of science in Africa," and the inception of a vast "research program for improving agricultural production systems." The African nations, it was pointed out in Nice, must equally participate in some advanced technologies, such as data processing, remote detection, and biotechnologies, which will determine their future independence. The participants stressed the need for more accessible and less expensive scientific information. They recommended the formation of an African Academy of Sciences, as well as the development of research on conventional technologies. The stated willingness of French participants to apply the recommendations formulated by the African nations during the Lagos conference, was acknowledged in Nice by Balla Keita, minister of research for the Ivory Coast, who claimed to be "very satisfied to see France become the advocate of a new international order, including in the scientific domain." [Text] [Paris AFP SCIENCES in French 4 Feb 82 p 7] 11,023

CSO: 3102/193

OVERVIEW OF SEVEN EUROPEAN AIRCRAFT INDUSTRIES

Duesseldorf VDI NACHRICHTEN in German 12 Mar 82 pp 13-19

[Article by Erhard Heckmann: "Focus on European Aircraft Industry"]

> [Text] Erhard Heckmann, for many years a special correspondent of VDI NACHRICHTEN, worked as a journalist in the aviation industry after the war, specifically, as translator; he began his journalistic activity in 1959 as editor with the magazines FLUGWELT and FLUGKOERPER. In 1963, he switched to a company with commercial flight operations representing various foreign enterprises in electronics and in the aircraft industry in the FRG; he directed the operation for 7 years. His technical knowledge is derived from production, sales, and aircraft operations. Since 1960, he has not missed a single air show at Farnborough, Le Bourget, or Paris.--The Editors.

Airbus Represents Competition with the United States

> With about 43,000 employees and a sales volume of more than 13 billion European currency units (1 ECU = DM2.50), the European LRI (aviation and space industry) is a hefty factor in the economy. The number of employees and the sales volume of the LRI companies in the EC thus amount to 40 percent of the figures from the United States. In coming up with the Airbus, Europe has challenged the American competition. Although the December 1981 monthly output was only 4.2 A-300 Airbus units, whereas Boeing produced more than 20 aircraft, the salesmen from Airbus Industry in 1980 were able to garner 50 percent of all orders for wide-body aircraft. In the European concert, the British aviation industry is the strongest on the Western continent.

It took 35 years to wind the British aviation and space industry down to peacetime levels after the war and to come up with an economically reasonable structure. That industry today employs more than 200,000 workers. The engine sector is particularly heavily represented with Rolls-Royce especially since this company is the only one outside the United States that comes anywhere near the American market leader, Pratt & Whitney, in terms of employees, although the sales volume is 40 percent lower. The product range offered by the equipment industry is

complete. By virtue of Great Britain's "special position" with respect to the United States--based on compensation for the purchase of nuclear delivery systems --British firms also have easier access to the American market.

Looking at it in overall terms, the most important enterprises in the British aviation and space industry today are the semigovernment system firm British Aerospace, the government-owned Rolls-Royce Ltd establishment as engine-maker, and Westland acting as helicopter producer. It is government and company policy to carry out minor projects--up to the size of the BAe 146 (see VDI-NACHRICHTEN, No 2, 1982)--on a national basis and larger ones on the basis of international cooperation.

British Aerospace sprang up in April 1977 as a result of the merger and nationalization of the aviation and space interests of Hawker Siddeley with British Aircraft Corporation and Scottish Aviation. The enterprise is subdivided into two groups, that is, the Aircraft Group which we want to look at in this report and the Dynamics Group which produces guided weapons. The concern employs 78,500 persons in Great Britain and abroad (including 2,500 in Saudi Arabia and Oman); in 1980, its sales volume came to 1.423 billion Pounds and it has orders on hand amounting to 3.5 billion Pounds. The enterprise was partly returned to private control in February 1981. The share capital is now widely scattered. Of the 115 million Pounds, 48.43 percent are in the hands of the government, 48.43 percent are in the hands of 87,500 stockholders, including 58,000 company personnel, and the remaining 3.4 percent are preferred shares for the employees.

One important reason for return to private control was the higher motivation of the personnel force because it was customary under the Labour government to grant big wage hikes also in government enterprises operating at a heavy loss--wage hikes which were way out of proportion to the earning situation of the enterprises. The taxpayer had to foot the bill.

Airbus Industry Has 20-Percent Share

The Aircraft Group of British Aerospace employes about 60,000 employees, subdivided in six enterprise divisions with nineteen plants in Great Britain and seven flight testing centers. Among the civilian programs we might emphasize the development of the BAe 146 feeder-line aircraft, participation in the Airbus (construction of wing and Chester Plant), and the Jetstream small airliner. The HS-748 turboprop aircraft and the HS-125-700 business jet are in production.

The four building lots released for the Tornado multipurpose combat aircraft encompass 476 aircraft. British final assembly is being accomplished in the Warton Plant where the developmental flying was done for the Tornado ADV air defense variant.

The Harrier VTOL continues to be much in demand. The Harrier GR Mk. 3 is in production for the RAF; the Sea Harrier is being produced for India (the aircraft for the Royal Navy have already been delivered); and additional AV-8A aircraft are being made for the Spanish Navy. McDonnell Douglas is working on the improvement of the AV-8B, with BAe as subcontractor. The VAF has ordered 60 and the U.S. Marine Corps has ordered 336 of that version. The Hawk Trainer, which in terms of

the numbers ordered had always been behind the Alpha Jet, was picked by the U.S. Navy with corresponding alterations for flight training, especially carrier operation. The delivery of 11 Nimrod Mk. 3 early-warning aircraft, converted to Nimrod Mk. 1 naval patrol [reconnaissance] aircraft, is scheduled to begin this year. This work is to be done by the Woodford Plant in Manchester.

British Aerospace participates in the Airbus program as a 20-percent partner of Airbus Industry through the production of the wing box in Chester. At a time when the British government had withdrawn from the Airbus program, the company--at that time still called Hawker Siddeley Aviation--was already making the air boxes as subcontractor, without any commercial risk. Hawker de Havilland (Australia) will supply wing ribs for the Airbus 310 on the basis of a subcontract from BAe.

Both versions of the four-jet feeder-line aircraft, the BAe 146, are being flight-tested in Hatfield. Plans call for 30 deliveries in 1983 and between 33 and 36 deliveries in 1984. The production of the HS-125-700 business jet is running at a monthly output rate of three airplanes. The new version, the Series 800, is not to get any new wing but only a wing with a greater wing span.

Westland Helicopters

The Westland Group at the time managed to escape nationalization so that this helicopter manufacturer today exists separately and privately along with the partly nationalized Airframe Industry. The Westland Group employs 12,500 workers, including 7,000 in helicopter construction. After the enterprise first of all built Sikorsky helicopters on a license basis or improved them further (for example, the Sea King, in service with the West German Navy, is a version of the Sikorsky S-61), the Lynx (also a shipboard helicopter used by the new German frigates) was the first in-house development as part of a British-French contract dating back to 1967-1968, calling for the joint development of three helicopter models--the Puma, the Gazelle, and the Lynx (at that time still called the WG.13). Project management for the first two models was handled by Aerospatiale and Westland handled the third one. The Lynx led to the WG.30 which can carry 16 passengers. The first shipments have been made, for example, to the British Airways, serving the Scilly Islands. The Sea King follow-on aircraft EH.101 is now being developed with Agusta. Other firms in this group are working on air-cushion aircraft, air conditioning systems, and hydraulic equipment.

Rolls-Royce

With 53,000 employees in the engine division and another 2,400 in the ship and industrial turbine division, Rolls-Royce is the world's second-biggest engine manufacturer. The production assortment extends from helicopter turbine construction in Leavesden via the big civilian jet engines of the RB.211 series in Derby all the way to the RB.199 military engines, Ardour, and the Western world's only engine for VTOL aircraft, the Pegasus, in Filton near Bristol.

The manpower subdivision is interesting: 46 percent are in production, 12 percent are in design, 19 percent are in the experimental division, 9 percent are in administration (including sales), 8 percent are in training, and 4 percent are in customer service.

Rolls-Royce missed the bus--if we may say so--with respect to the Airbus program. After the debacle with the RB.207--which led to the collapse of the enterprise in 1969--Rolls-Royce put its money on aircraft manufacturers in the United States. It thus became a supplier for the launching customer (first-time customer) of the Lockheed Tristar and the Boeing 757 with powerful support from British Airways, the national airline company.

A new development program is being pursued together with four Japanese firms; this is the RJ.500, an engine for the new 150-seat airliners. After Fokker and McDonnell Douglas split and since Boeing is not thinking of marketing an aircraft in that category prior to 1988, the company is pursuing this development somewhat more slowly. But regarding the Airbus 320, the company is involved in tough competition with all other engine makers throughout the world.

The Government Runs the Show in France

In-House Developments Guarantee Independence for Exports

The French aircraft and aviation industry is an important factor in the export industry and therefore has the full support of the government and its subordinate agencies not only in research and development but also in sales. The French government's attitude toward weapons exports--regardless of whether the administration happens to be conservative or socialist--is determined by a sober and practical approach.

In 1980, the industry employed almost 110,000 people, subdivided as follows: 60,100 in the airframe industry, 23,000 in the engine industry, and 26,000 in the equipment industry. The strength of the French equipment industry is particularly noticeable; it was built up systematically with the help of government support and today employs more than twice as many persons as the German equipment industry. The French aircraft and space industry's sales volume came to Fr33 billion in 1980. Goods worth FR19 billion were exported and the industry received FR27 billion in orders from abroad.

France also has two system firms, the government-owned Aerospatiale (SNIAS [National Aerospace Industry Company]) and Marcel Dassault Breguet Aviation, in which the government has been holding the majority share since the autumn after Marcel Dassault several years ago had to accept almost 50-percent government participation as a result of the belly landing with the Mercure (the domestic political clout of the manufacturers prevented full nationalization). These two companies are separated in a very simple manner: Aerospatiale handles transport aircraft and airliners as well as guided weapons and helicopters; Dassault takes care of combat aircraft and business aircraft.

Concerning the order of magnitude, Aerospatiale--with 39,000 employees and a capital stock of Fr447 million, plus a sales volume of Fr13 billion--roughly corresponds to MBB [Messerschmitt-Boelkow-Blohm]. The Airbus accounts for a considerable portion of the sales volume. Aerospatiale produces the forward section of the fuselage with the cockpit, the wing center boxes, and engine parts. Final assembly of the A-300 and the A-310 takes place in the Toulouse Plant. A new shop was build for the assembly of the first two A-310 units; it is then used for

the extension of the final assembly line of A-300 and A-310 aircraft because both versions are to be assembled in a final fashion on the same assembly line.

Helicopter production is quite considerable including the following types:Alouette, Puma, Super Puma, Gazelle, Dauphin, Dauphin 2, and Ecureuil. The missile division produces the AS.30 air-to-ground missile and the Exocet naval missile; it is developing AS.15 TT for navy helicopters, the follow-on system for the Pluton tactical nuclear missile, and the ASN supersonic naval missile together with MBB. Hot, Milan, and Roland are being produced in the context of Euromissile.

With a subscribed capital of Fr501 million, a sales volume of FR10.7 billion, and 16,000 employees, Avion Marcel Dassault Breguet works in two main areas in aircraft construction: the combat aircraft of the Mirage family and the business aircraft of the Falcon series. Dassault is the French partner of Dornier in the Alpha Jet program and it is also the partner of British Aerospace in the Jaguar program. The Mirage 2000 is being developed for the French Air Force and has already also been ordered by India. The heavy, twin-jet Mirage 4000 has not yet found any customers. If German-French cooperation were to materialize in the context of the combat aircraft for the 1990's, the TKF [Tactical Combat Aircraft], then Dassault would be the partner.

The French engine industry consists of three companies, that is, SNECMA [National Corporation for Aircraft Engine Design and Construction], Turbomeca, and Mircoturbo [as published]. Government-owned SNECMA is the biggest enterprise with 11,500 employees (excluding partner companies or subsidiaries). The ATAR family engines still account for most of the deliveries. The M53-5 is now also in production for the Mirage 2000 and the more powerful version, the M53-P2 is being developed for subsequent building lots of the Mirage 2000. More than 1,200 engines have already been ordered of the Larzac 04 model for the Alpha Jet. A partner is being sought for the development of the M88 which is planned as an engine for the combat aircraft of the 1990's. France heavily concentrates on in-house development for military engines even in case of enormous development costs because it wants to be independent when it comes to exports. An affiliate of SNECMA and General Electric is CFM [expansion unknown] for the CFM 56 program, an engine for the conversion of Boeing 707/KC-135 and DC-8 aircraft and, in more powerful versions, for the 150-seat airliners.

With 4,400 employees, Turbomeca produces mostly shaft-horsepower turbines for the helicopters of Aerospatiale and turboprops and, in cooperation with Rolls-Royce, the Ardour engines for Jaguar, Mitsubishi T-2, F-1, and the British Aerospace Hawk. The enterprise is also involved in the Larzac program.

Small turbojets made by Microturbo are used air-breathing missiles and small aircraft.

The Italian Miracle

Consolidated Industry with Clear Program

The astonishing aspect of the Italian aircraft industry is the fact that this country, in spite of its disorganized financial organization, manages, in addition

to the AMX, also to build a G.91 follow-on aircraft and moreover, with the Agusta A-129 Mongoose, to develop an AT helicopter, while the words TKF and PAH-2 (AT helicopter 2) have become the bugaboos of financial planners in the FRG. In addition, the Italians are also building and exporting the G.222 transport aircraft.

With somewhat more than 40,000 employees, the Italian aircraft and space industry in 1981 achieved a sales volume of about 1,500 billion lire, in other words, just about DM3 billion. In the Romance-language countries, people apparently believe in the blessings of a nationalized industry. In Italy, nationalization assumed a special accent by virtue of the fact that the two government finance holding companies, the EFIM [Manufacturing Industry Holding and Financial Company] and IRI [Industrial Reconstruction Institute] have been bitterly feuding with each other for many years. A settlement was worked out only last year to the effect that Aeritalia is to take care of combat and large aircraft while Agusta will handle helicopters and light aircraft. Here again of course there are exceptions which to be sure would not be a subject for this report.

The nationalization process began in 1969 with the merger of the aircraft construction activities of Fiat and those of government-owned Finmeccanica [Mechanical Engineering Finance Corporation], the Aerfer and Salmoiraghi companies, all of which were combined into Aeritalia, with Fiat and Finmeccanica each taking one half. In 1976, IRI-Finmeccanica then took over the Fiat shares and this meant that the company was fully government-owned. In 1979, the company name was changed to Aeritalia Societa Aerospaziale Italiana. At the same time, a part of the activities was shifted to southern Italy and the company headquarters was moved to Naples as part of the effort to promote the economy of the Italian South.

Combat aircraft development and construction remain in the Turin area (formerly Fiat Aviazione), in other words, the construction of the swingwing used in the Tornado as part of the three-nation project and final assembly of the 100 aircraft for the Italian Air Force. This is also where the G.91 follow-on project, the AMX, is being handled. The entire Italian aircraft industry and Brazil, through EMBRAER [Brazilian Aeronautics Company] (30 percent) are involved in this program. The engine for this close-support fighter is the 807 version of the Rolls-Royce Spey, without afterburner. Two final assembly operations--one in Italy and the other in Brazil--have been planned. The prototype is to fly in 1983. Commissioning is anticipated for 1987.

The headquarters of the transport aircraft division is at Pomigliano d'Arco (Naples), with the Pomigliano, Capodichino, Casoria, and Foggia plants. The G.222 military transport aircraft is being built here (maximum takeoff weight 28,000 kp); 70 of these aircraft have already been sold, including 44 to the Italian Air Force. For Libya, the General Electric T64 turboprop engines were replaced with Rolls-Royce Tyne for embargo reasons.

In contrast to most other European countries, the Italians initially did not think that the Airbus would have any great chances of success so that Aeritalia participated in the Boeing 767, the competitor of the A-310, at its own risk. For American aircraft, Aeritalia produces the vertical fin with rudder, elevator, spoilers, wingtip caps and mobile parts of the wing, many of them consisting of

CFK (carbon-reinforced synthetic material); Aeritalia is one of the biggest producers (and perhaps even the biggest producer) of sandwich material parts for civilian aircraft. But the company also works for Boeing competitor McDonnell Douglas, including the fuselage shells for the DC-9-80, vertical fins for the DC-10, and, on the basis of a subcontract from the McDonnel Douglas subcontractor, the Convair Division of General Dynamics, it makes fuselage shells for the DC-10. It is therefore only logical to expect participation in the A-320 150-seat Airbus.

Now that both governments have agreed on the joint execution of the project, Aeritalia and French Aerospatiale are pursuing the development of the 40-50-seat turboprop aircraft for regional traffic, the ATR-42. This effort is aimed at the market of the Fokker F.27 and the BAe 748, a market which each year sells an average of 30 aircraft worldwide. But when governments are behind such an effort, customers can be "ordered to step forward." As part of its reorganization, Aeritalia has now also inherited Partenavia and it a partner in Aeronautica Macchi and Meteor. Aeritalia's annual sales volume in 1980 was 277 billion lire (about DM55.4 million); for 1981, it has been estimated at almost 340 billion lire (DM680 million).

After last year's capital increase from 18 to 118 billion lire, the Agusta Group is now more than 80-percent government-owned via the financial holding company called IFIM. The rest is held by the Count Agusta who has managed to grab all export business (the group's export share is 78.5 percent) in the form of Agusta International. The company employs 9,500 persons, primarily for helicopter construction. In 1980 the sales volume was about 450 billion lire (about DM 900 million).

The program includes license construction of the Bell 206 JetRanger and the Bell 212 helicopters, the Boeing Vertol Chinook, and the Sikorsky S-61. Agusta is now the only producer for the Sikorsky helicopter. The A-109 was the first in-house helicopter to be developed. The Sea King follow-on model, the EH-101, is being developed together with Westland. The first of five prototypes for the A.129 Mongoose AT helicopter is to fly in June of next year; the plant hopes to be able to export it also to Germany. The Agusta Group also includes SIA Marchetti and Caproni Vizzola.

Belgian Aircraft Industry's F-16 Output Sputtering

The following also applies to the Belgian companies: full employment at this moment but an uncertain future. Apart from the Belgian assembly line in Gosselies, the Belgian companies rather got the short end of the stick when it came to distributing the construction job on the General Dynamics combat aircraft under the F-16 joint production program because only Belgium, among the participating countries, had an engine company in the form of the FN (National Factory) in Herstal. This means that Belgium had to concentrate mostly on engine building.

Belgium handled the final assembly for the 116 F-16 aircraft for the Belgian Air Force and the 58 aircraft for the Danish Air Force. Sonaca [expansion unknown] is also making parts, turning out the tail end and the vertical fin, while SABCA [expansion unknown] makes the tail end.

Production Break due to Money Shortage

Final assembly in Gosselies is scheduled to run out by the end of 1984. Considering the raw materials and parts involving long delivery deadlines, Belgium at the end of 1981 already had to place orders for additional F-16 aircraft as replacement for the obsolete Mirage aircraft. Due to a shortage of funds, the Belgian government had to postpone the decision--Dassault is still in the running with the Mirage 2000--until 1986 and that means an interruption in production. A promise had been given, to be sure, to help the industry over the "no-job" period but one can easily figure out what an industry can think of such promises when the government keeps changing.

The oldest Belgian aircraft company is SABCA which was founded shortly after World War I. Its part-owners today are Dassault and Fokker. The Haren and Gosselies plants employ 2,100 persons. About three-quarters of the sales volume comes from Haren and 25 percent come from Gosselies which primarily handles final assembly, overhauls, repair, and initial flight testing because an airfield is available there. The actual production effort is underway in Haren. For the F-16 Program, SABCA produces the wing box, the hydraulic servocontrols, and the final control elements. For the Alpha Jet, it produces the fuselage sections, for the Mirage F1 it produces fixed vertical and elevator surfaces, for the Boeing 737 it produces hydraulic regulating units, for the Airbus it produces Krueger flaps, and for the Fokker-F-27 Friendship it produces outboard wings.

Sonaca has been in existence only since the spring of 1978 as a receiver company for S. A. Fairey which had gone into bankruptcy a year earlier. The Belgian company participates in it to the extent of 50 percent. FN holds 24.4 percent, followed by AIT [expansion unknown] Electronics with 12.2 percent. The rest are divided among ACEC [expansion unknown], SABCA, and Cartonex. The company employs about 2,000 workers. Broken down by programs, 50 percent of the sales volume consists of F-16 aircraft, 25 percent consist of Mirage F1, 5, and III, while 3 percent consists of the Alpha Jet. Furthermore, 350 workers are employed in making parts for the Airbus (Krueger flaps). A new shop is under construction for the production of synthetic components.

Although involved in the J79 follow-on program for the Starfighter, the establishment of the FN engine division--which acquired a worldwide reputation primarily through weapons production--took place very quietly. In this way, one of the world's most modern production enterprises sprang up in nature, providing jobs for 2,600 workers. The plant makes ten Pratt & Whitney F100 engines for the joint F-16 production program per month. The customer is the U.S. Air Force. The F100 sales alone over a period of 5 years will come to more than 30 billion Belgian Francs (about DM1.2 billion). The worries of Sonaca and SABCA do not directly touch FN. Engine production is supplemented by basic overhauls of J79 and ATAR engines for the Belgian Air Force but it is expected that FN will also be involved in the maintenance of the F100 aircraft of the U.S. Air Force in Europe.

Fokker in Holland Facing Fresh Civilian Production Start

Stubbornness need not necessarily be a negative quality. In business however it increases the risk. When the Dutch government decided in the past--urged on by

Fokker, the nation's producer--not to join the Airbus consortium, but rather to use considerably larger amounts for the construction of a domestic project with a partner from the United States, the industry proved to be ready to face risks. Salesmanager D. Kroog was hired away from Airbus Industry and made program manager; after an impressive (and expensive) presentation at the 1981 Paris aviation show, the joint design team in Long Beach for the project of the 150-seat MDF-100 was beefed up to 400 men.

Early in February 1982, this partnership broke up. Fokker's expenditures for the project so far would seem to have exceeded about 200 million Guilders. After this debacle, all Fokker could do was to go back to the Airbus where partners are still wanted for the 320 project.

The Dutch enterprise, whose principal partners are Northrop with 20 percent, a Belgian bank consortium with 13 percent, a Dutch consortium with 10 percent, and the Begerhaut family, after separation from VFW [Fokker United Aeronautical Works], currently employs about 8,800 workers. The sales volume would seem to be 1.2 billion Guilders for 1981. The oldtimers F-27 Friendship and F-28 Fellowship are still in production with a monthly output of, respectively, two and one-and-a-half aircraft. After the discontinuation of the MDF-100, increased efforts are to be made for the modernization of both of these models. It nevertheless remains doubtful whether the market for this aircraft category can be expanded because, after all, Aeroitalia/Aerospatiale are also crowding into that market now and British Aerospace is also established in it with the BAe 748.

Concerning military aircraft production we might report that the F-16 program--in whose context Fokker handles final assembly of all the aircraft for Holland and Norway, also producing the mid-section of the fuselage and movable wing parts--is included in the plan and that the Dutch government is stepping up its orders year after year, thus assuring domestic industry of a rising compensation share.

Aircraft for Special Requirements

Sweden's Aircraft Industry at the Crossroads

> The Swedish aviation industry, which began to develop its own aircraft only during World War II--until then, Sweden had been making American, British, and German models on a license basis--is subjected during these weeks to a decision by the administration as to whether the country should in the future build its own combat aircraft designs or whether, saving the money needed for development, foreign models should be made on a license basis. Considering Sweden's special operational requirements, top military commanders recommend the development of a Swedish "JAS" model as the follow-on aircraft for the "Sk.60" and the fighter-bomber version of the "Viggen" which can be used as fighter, reconnaissance aircraft, and fighter-bomber by means of rapid conversion. Parliament is to take up the final decision in May.

In the past, Swedish military aircraft have always been distinguished by their progressive originality. The Saab-21A fighter-bomber from the year 1943 had a center cabin and a double tail assembly carrier, as well as a pusher propeller and an ejection seat for the pilot. The Safir trainer came out immediately after the war; it was sold to 20 countries although the number of aircraft sold was not large. The Saab 29, the "Flying Barrel," flew already in 1948; it had a jet engine and swept wings--ahead of the American model. The Saab 32 Lansen from 1955 already had a search radar. At that time, the prototype of the Saab 35 Draken already had a delta wing and air intakes far forward. In 1960 it was ready for issue to the units. It was followed as a no less spectacular design by the Viggen, a fighter-bomber with swept wings and canards--here again the first design of this kind in the world. The Viggen today exists in the following versions: AJ-37, a fighter bomber; SF-37, a reconnaissance aircraft; SH-37, a naval patrol aircraft; SK-37, a two-seat trainer; and JA-37, an air superiority fighter which is still in production. There is one feature that was common in all of these aircraft: the engine was built on a license basis, first of British and later of American origin.

The pending decision involves JAS, a joint project of the Swedish industry. To be able to build an adequate number of aircraft, the size, in other words, the weight was limited from the very beginning, specifically, not only via the price--no more than 60 percent of the Viggen aircraft price and only half as heavy as the latter (in other words, 8.4 t)--as well as the selection of the engine. Here it was decided rather early to pick the General Electric 404J, a more powerful version of the engines of the McDonnell Douglas F/A-18 with a thrust of almost 80 kN with afterburner. The aircraft frame is to consist of 30 percent of sandwich materials (carbon-fiber-reinforced and, for the radome, glass-fiber-reinforced synthetic materials); compared to the conventional metal structure, this makes it possible to achieve a weight saving of 25 percent.

The control system is digital-electronic by means of fly-by-wire. The design calls for a delta wing with unattenuated, attached canards, in other words, reduced stability in the subsonic range. The weapons payload is to correspond to that of the Viggen. Because no separate reconnaissance version is to be developed, the reconnaissance equipment must be capable of being carried along on the outside. The development of the multipurpose radar is being handled by L. M. Ericsson, while SRA [expansion unknown] is responsible for the radar screens and instruments in the cockpit.

The typical Swedish requirements include a short takeoff run of 500 m, which means an operational capability from 1,000-m improved runways (sections of highway), long takeoff readiness by means of a powerful auxiliary turbine, and above all easy maintenance by draftees who at least are to be in a position to replenish the ammunition of the aircraft and to refuel them. The specifications furthermore call for a supersonic capability in all flying altitudes.

The Swedish aircraft industry--in other words, the Saab-Scania, Volvo Flygmotor, L. M. Ericsson, FFV [expansion unknown], and SRA Communications (an affiliate of L. M. Ericsson)--have declared themselves ready to provide in-house funds for this product, specifically, for the preliminary phase and for development to the tune of 200 million sk [Swedish Crowns] (about DM100 million), after the administration had made the same large amount available in June 1980. This financing is to run out in 1982.

To become more independent of the periodic fluctuations in the military trade, the enterprise concept of Saab Aerospace calls for achieving a 50 percent sales volume share in the civilian sector. The enterprise is thus participating in foreign civilian projects as subcontractor. The company is making the flaps for the McDonnell Douglas DC-9-80 and it is making control surfaces for the British Aerospace 146.

The most ambitious project which Saab-Scania has tackled is the joint development of the 34-seat feeder-line aircraft model 340, together with the American firm of Fairchild. The Swedish enterprise bears the main burden with 70 percent and has erected a completely new production shop with a surface area of 250,000 m^2 plus 5,000 m^2 office space in Linkoeping. The amount of 200 million sk is being invested for this aircraft project alone, plus of course the machinery. The 340 model is powered by two General Electric CT7-5 turboprop engines with 1,175 Wkw [shaft kw?]. Here are some additional data: cruising speed 480 km/hr, range 1,280 km; required takeoff run less than 1,200 m, cabine overpressure 0.5 bar, maximum takeoff weight 11,340 kp.

Right Partner for Feeder-Line Aircraft

In weighing the risk of this kind of undertaking, the first question was why one should pick Fairchild as partner, of all things. Why not a manufacturer of general aviation aircraft? Why not one of the well-known makers of airliners? Well, Saab-Scania had a good reason for its choice of partners. Although the American company in the distant past became known only through the license construction of the Fokker Friendship, it nevertheless since its takeover by Swearingen--the maker of such well-known aircraft as Metro II, Merlin III, and IVA--has good sales experiences on a difficult market which is not known to the makers of large airliners. The potential customers do not keep Boeing, Lockheed, Douglas, or Airbus aircraft. At most, only British Aerospace, De Havilland of Canada, and Fokker are on this special commuter market.

Whether the prediction that the worldwide need for aircraft in this category is around 2,000 is correct, that is something only the future will show. The past at any rate shows that the calculations of the market researchers in the aircraft sector are roughly comparable to the probabilities of the weather bureau. At any rate, Linkoeping is prepared for a monthly output of seven 340 models. The 6,000 employees at Saab Aerospace in 1980 achieved a sales volume of about more than one billion sk. By the way, during the postwar years, Saab went underground; most of the metal-cutting production phase is 40 m under the granite. It is realized today that such a plant does not offer adequate protection against direct atomic weapons hits. But the machine tools are on solid foundations.

Civilian Developments Being Promoted

Another division of Saab-Scania is also concerned with aviation technology; Saab Jonkoeping employs about 1,000 workers and is involved in the development and construction of training instruments, target illustration systems, simulators, gyros, sights, and electronic components.

Volvo Flygmotor is an affiliate of AB Volvo, Scandinavia's biggest industrial enterprise. Volvo Flygmotor employs about 2,900 persons. The 1980 sales volume of

757 million sk is proof of the vast production program. The RM8B engine is currently in production for the JA 37 Viggen; this is an improved version of the RM8A, the military version of the Pratt & Whitney JT8D with an afterburner developed by Volvo. Volvo is also looking to civilian development. From Garrett TFE731, Volvo developed its military version, the TFE 1042, which could be used in light fighters in a double installation. The company has a 15-percent share in the development of the Garrett TPE3331-14/15 turboprop. If a decision should be made on the new JAS combat aircraft, Volvo would be involved in the construction and improvement of the General Electric 404. Parts production for the other engine manufacturers, such as Rolls-Royce, MTU [expansion unknown], SNECMA, Garrett, and Bendix, the equipment company, is important for sales because that accounts for 25 percent at any rate.

The company maintains a series of engine test stands. One of them should be emphasized particularly because it guarantees the testing of complete engines with afterburner at sea level at simulated Mach 1.1. The incoming compressed air is generated by means of water influx going into the underground cavern.

Only at the end of last year did the Swedish aircraft industry get together to form an association--Swedish Aerospace Industries--as a member of the AECMA [European Association of Aerospace Equipment Builders], the European Aircraft Industry Association. Sweden to be sure is located somewhat along the periphery but its aircraft industry does deserve recognition.

German Aircraft Builders Well Employed

DM-10 Billion Limit in Sales Seems to Have Been Passed--76,000 Employees

> The German aircraft and space industry will demonstrate its capacity at the Hanover-Langenhagen Airport between 18 and 25 May as part of ILA (international air show] 1982. Chancellor Helmut Schmidt certainly will not be able to be stingy with recognition for past performance in his opening address but he will not fail to sound a warning either. One cannot make any promises when one's pockets are empty. With a total of 76,000 employees, the German aircraft and space industry is rather well employed through the Airbus, Alpha Jet, Tornado, and Bo 105 production programs. The 1981 annual sales volume would seem to have topped the DM-10 million limit. The existence of the development reams is a matter of concern in view of the research and development fund cutbacks.

On the topic of entrepreneurial cooperation, Professor Gero Madelung, chairman of the MBB business management, during the New Year's reception in Ottobrunn, urged staff members who are able to do so to carry out their ideas so as to earn a profit for the enterprise. In so doing he touched on a problem which in the past was tackled in a wasteful fashion as far as the national economy is concerned and which was not handled in an optimum fashion in terms of enterprise management. There was criticism to the effect that too few marketable products were coming out of the Ottobrunn think tank. The truth is that there was an inclination to file away some discoveries from research and technology which were not suitable for marketing in the company itself in order not to give the competition any ideas;

instead, this should have been handled more cleverly by means of license awards or by founding partnership companies so as to participate in their practical production efforts.

All big enterprises are having trouble converting development results into production (this process recently has been called know-how transfer although it comes from technology transfer to other companies); and they find it even more difficult to market them. The accusation concerning the marketing and sales weakness of companies of the LRI (aircraft and space industry) is almost classical now to the extent that this involves products which cannot be offered to the chief customer, that is, the government. The wealth of ideas of the engineers is lacking in the businessmen. They often lack a sixth sense for market opportunities.

And this is precisely what Madelung means by "entrepreneurial copperation." No organizational chart in any big enterprise can make sure that the sales maturity of a particular development item will be recognized at the right time. This is where the staff members must be motivated and addressed on all levels. Of course, mere words are not enough. We must provide incentives. The word "entrepreneurial" also contains the element of risk. The staff member must be made to share in the risk to a tolerable degree--and of course also in the profits. Looking at Ottobrunn, from which social-policy suggestions have already come, we might just mention flexitime, exemplary advanced education, social welfare, and similar concepts and we expect new signals in the entrepreneurial field.

With about 38,000 staff members, an annual sales volume of DM4.6 billion, and an order inventory of DM7.6 billion MBB grew to internationally significant dimensions after the purchase of VFW. The capital was increased last year from DM278 to DM378 million; the UF [aircraft division] enterprise division for combat aircraft has 7,100 employees; the UT [transport division] transport aircraft and airliner plant division managed from Hamburg has 17,000 employees; the UD [rotary-wing and transport aircraft division] employs 5,600 persons (including the freight car construction plant in Donauwoerth); the UA [apparatus division] handles weapons and employs 4,500 persons; the UR [space division] employs 2,200 persons and is managed from Bremen; the UM [navy and special equipment division], likewise based in Bremen, employs 1,000 workers. The figure is rounded out by about 3,000 part-time workers in all divisions. Broken down over programs, we find that 10,000 workers are assigned to the Airbus, 7,500 to the Tornado, 4,900 to weapons, 4,000 to helicopters, and 2,200 to aerospace activities.

In the context of medium-term investment planning, DM1.3 billion are to be invested over the next 5 years in production plants because high wage costs and fluctuating exchange rates call for the most efficient possible production efforts. New-type automatic riveting machines are being installed in Hamburg and new production facilities are being put up for sandwich materials.

Earnings are good from the production of the Tornado combat aircraft because the company undertook the risk of concluding the contracts with fixed prices. Price escalation in this program in other words was not caused by industry and therefore need not be justified by industry. The concerns spend DM140 million per year for research and development. Starting in 1982, 25 percent more than shown in the finance plan are to be invested in R&D because these R&D expenditures are investments that constitute the prerequisites for future profits.

"MBB Facing Difficult Years" is the headline in the January edition of the in-house publication MBB AKTUELL. Well, it was impossible to charge the plant management in the past with having painted an excessively optimistic picture of the future. Nevertheless, MBB is currently in rather good shape on the whole. Airbus, Tornado, and Bo-105 are in production and even the railroad business is running well; the company is still adequately busy in aerospace activities and guided missiles are finding their market.

The problems are caused by government fund shortages. Years ago it was figured out that the production of the F-4 follow-on aircraft can be hitched up to the Tornado program but--to quote Bert Brecht--that is not the way things happen to be.

The first one to be hit is the development station for military aircraft. Here there is a personnel surplus. For a year now MBB has been pursuing the project of an air defense fighter under the overall concept of TKF which is to be superior to possible enemy fighters by a factor of two or three. The idea is to come up with a single-seater with canard wings and delta main wing, with reduced longitudinal stability and the super "Stall" and properties, direct power control, and fuselage targets [as published]. The technological targets are pegged very high but the company is also ready to pay for that or to make its own development contribution. The German equipment industry has also been urged to participate, just as the British industry is doing with the P.110 project. A foreign partner is still being sought. It might possibly come from France, especially since British industry shows no great interest due to German arms export restrictions.

The topic of in-house work by industry is in vogue during times of government fund shortages. MBB offers in-house financial participation also for the PAH-2. In a market which is really restricted by government requirements, this kind of in-house participation contains a certain degree of illogic. If the government has no money to finance a development whose only customer it is, in other words, if it denies industry a change for profitable exports, then it cannot expect industry to come up with any preliminary services without giving a guarantee which however budget law prevents the government from doing.

In the experimental program for new combat aircraft, CCV equipment plays a special role. These control configured vehicles are flying devices with reduced aerodynamics stability which are stabilized by technical control measures. The objective is not only to reduce air resistance but also to design the aircraft according to flight control or flight performance criteria. CCV [control configured vehicles] also facilitate flutter suppression when payload is carried outside and it reduces the turbulence resonance during low-level flights.

The CCV experimental program was begun in 1974. An F-104-G Starfighter was modified by means of the installation of a canard surface behind the cockpit, the attachment of a tail trim weight of 650 kg, and the installation of a quadruple redundant digital light control and regulating system. Shortly before the end of the year, the aircraft was flown with negative longitudinal stability of 20 percent (20 percent of the average wing depth behind the neutral point); this is something nobody has been able to do before that anywhere in the world.

Bo-105 Helicopter a Success

The helicopter division is running at full speed. The Bo-105 prevailed on this market, even in the United States; the licensing of the joint German-Japanese BK-117 project is in progress and the development of a light transport helicopter is with the realm of possibility. This would be 6 t Bo-108; it is hoped furthermore that a development contract might be received for the second-generation AT helicopter with France.

France is also the partner with Euromissile for the Milan, Hot, and Roland missile systems which are being made in the apparatus division. National programs on the other hand include the Kormoran naval missile as the main armament of the German Tornado naval aircraft and the WM-1 multipurpose weapon.

The integration of VFW into the MBB enterprise sector structure was not too difficult after the workshop concept which had been agreed upon even before the merger. The former VFW staff members will have to be patient for several years until they can obtain the same rights in the social benefit sector as their colleagues who have more seniority in the MBB plant store--and this in particular involves the plant retirement plan.

No Structural Problems at Dornier

The Dornier Group looks to the next several years with confidence. Although the 175th and last Alpha Jet is to be delivered to the German Air Force in the summer, production continues due to the slower acceptance rate of the French as well as export contracts. It is hoped--and this may well be unique in this industry--to create a smooth transition from Alpha Jet production to civilian production in the commuter aircraft family. This naturally does not mean that the company wants to drop military aircraft construction in the future; instead, it implies a welcome risk distribution along with growth potential.

All possible solutions for a TKF, in other words, a technical combat aircraft, as the follow-on aircraft for the Phantom, are being investigated; the concept of "follow-on aircraft" is not quite correct because the mission of a present-day combat aircraft can tomorrow certainly be taken over by other weapons, such as missiles. As we said before, Dornier still has the ball and is running with it. The company is investigating the entire spectrum, both in the context of production cooperation with Northrop, about whose scope nobody wants to comment, although we may assume that Northrop basically advocates the very maneuverable light-weight fighter, partly through the investigation of improvements of the Alpha Jet which might possibly also cover a portion of the Phantom tasks--in other words, not only air combat but also reconnaissance. Production cooperation with Dassault therefore cannot be ruled out either. There is an agreement with General Dynamics concerning the various versions of the Tomahawk cruise missile.

Among the German aircraft and space industry companies, Dornier would seem to have the best export organization. This is naturally explained by the nature of the product and the flexibility and skill of the management. Anybody who wants to sell aircraft worldwide must be able to be present everywhere. Naturally, certain main points will also take shape, such as Nigeria in Africa, as well as

in Asia--although we must not say that as yet—and Argentina of course in South America. The IA-63--an armed trainer--is one of the production cooperation projects; it was displayed for the first time at the 1981 Paris Air Show; it is an investment for the future together with the partner, the FMA, a firm of the Argentine Air Force.

The Dornier Group--one of the two family enterprises in the aircraft industry and probably the only one in the world that is still fully owned by the founder's family--employs a little more than 8,500 workers, including about 1,000 in the Lindauer Dornier-Gesellschaft mbH [Incorporated], which makes textile machinery; 4,500 workers are with Dornier GmbH; 1,550 work for Dornier Reparaturwerft [Repair Yard], and 1,500 are with Dornier Systems GmbH. The latter is mainly concerned with research and development in the field of space travel, new technologies, electronics, consultations for planning, and integrated security systems.

Development and construction of aircraft, rotary wing devices (Kiebitz biplatform), missiles, equipment for the navy and the army, as well as command systems are in progress at Dornier GmbH with primary production facilities in Munich-Neuaubing and Friedrichshafen, as well as 300 employees in Oberpfaffenhofen (final assembly). Dornier Logistik, which is a part of the corporation, increasingly accepts training assignments and is one of the enterprise's growing divisions.

The repair yard provides care and maintenance. Its job for example also includes the integration of mission electronics into NATO's AWACS. Field maintenance stations are being operated in Lagerlechfeld (GFMS [expansion unknown]) and at the Frankfurt Airport.

Alpha Jet production provided most of the sales volume which would appear to be more than DM1.1 billion (the balance sheet will not be published until July). This project, which was concluded at fixed prices, is a profit-earning proposition. It consists of about 2,500 jobs. The subsequent wind-down of Alpha Jet production is to be made up through the start and high-gear operation of commuter aircraft production (small airliners). The machinery, especially for metal cutting, is designed to facilitate that. There are 120 orders or options available, in other words, 120 delivery positions have been filled, for the small airliners with up to 19 seats. Recently, the Federal Aviation Bureau issued the model license for the smaller Do 228-100 (15 seats) just 8 months after the maiden flight.

In spite of reciprocal government agreements, the licensing authority of the United States (FAA) is setting up bureaucratic obstacles although one can expect the American license to come through soon; this is true even though FAA inquiries relate more to the number of sales units on the North American continent rather than to technical details. The Do 228-200 will follow shortly; it differs only by virtue of its longer fuselage. One of the really promising future projects being worked on by Dornier is the experimental TST (transsonic wing) which is to be used on the Alpha Jet-A that has been converted into an experimental unit with a wing characterized by a transsonic profile with a big nose radius and a relatively flat surface curvature in the forward profile sector and a stronger arch in the aft profile sector. The results of the initial flight testing phase completed in December are now available. Experimental flights in the 15° maneuver flap configuration

were carried out recently in Manching after the flight sector for all configurations had been blown corner-to-corner with and without maneuvering flap positions. The maneuver flaps, which until now could be adjusted only on the ground, are to be checked out during the next test stage in flight as a function of the flying speed and the angle of attack in order, finally, to control maneuver flaps automatically as a function of the flying state. The TST profile is 18 percent thicker than that of the Alpha Jet series-produced wing. Nevertheless, the fuel consumption is less, particularly in the faster speed range. With an integral tank in the transition between the wing and the fuselage, the TST wing gives us an action radius which corresponds to that of the series-produced Alpha Jet with two auxiliary tanks.

"Tornado"--Automated Production

The World's Currently Most Modern Aircraft Factory is in Augsburg

> The U.S. Air Force has just tackled a program for the modernization of its aircraft production enterprises under the slogan "Aircraft Factory of the Future." Here we must realize that many enterprises in the American aviation and aerospace industry do not own the plants and the production equipment. Until 1986, about $100 million will be made available for modernization from the U.S. Air Force budget; enterprises operating these plants are required to come up with a similarly large amount. Now, something which is to materialize in the United States by the middle of the 1980's is already in existence--at MBB in Augsburg.

After Great Britain, the FRG, and Italy had decided to equip their air forces with the Tornado multipurpose combat aircraft, the production effort was also distributed according to the basic principle of each country getting a final assembly facility for the aircraft it had ordered itself; production as such is handled according to the Single Source Principle, in other words, it takes place only in one location, also for the partner countries. In keeping with the stipulated construction breakdown--47.64 percent for Great Britain, 40 percent for the FRG, and 12.36 percent for Italy--British Aerospace makes all forward fuselage sections, including the cockpit, the tail section of the fuselage plus the tail assembly, and the weapons stations on the underside of the fuselage. The Italian partner, Aeritalia, makes the movable part of the wing plus flaps, rudders, and struts. The center section of the fuselage is produced at MBB in Germany with the plants of VFW, the affiliate, in Bremen getting 35-40 percent of the value.

MBB in Augsburg does the milling for the walls of the wing box made of titanium sheets, assembled by means of electron ray welding, assembled and checked out in fully equipped fashion on a double assembly line with the components made in Bremen and by other MBB plants. The aircraft's final assembly with the main structural components and engines delivered from Great Britain and Italy takes place in Manching for West German Armed Forces aircraft.

Large-Scale Projects Demand Production Cooperation

Each industrial enterprise--even an enterprise which might hold a monopoly in its own country--is subjected to competitive pressure, specifically, competition from foreign companies. Large-scale projects call for international production cooperation and a partner; anybody who cannot keep up, be it financially or technically, is no longer considered a partner, is no longer considered a system firm with equal rights, but as a subcontractor or supplier. It must therefore also be a part of government economic policy to strengthen these system firms.

The MBB enterprise management's decision to invest DM100 million in the Augusburg Plant cannot be divorced from the Tornado program. Roughly at the same time, it was also necessary to put Airbus production into high gear. There were thus two reasons to modernize the plant so that large aircraft structural components might for the first time be produced on an industrial scale: first of all, the high wage level in the FRG and, next, the development of new computer-controlled production technologies which alone assure automatic production.

In a joint project, such as Tornado, it is obvious to compare the rise in material and production costs for an aircraft in type in the FRG with those of Great Britain and Italy, the partner countries. Production costs in Germany from 1970 until 1978 went up 207 percent; in Great Britain they went up 315 percent and in Italy they rose 458 percent in terms of the particular currency. This relatively favorable increase rate in the FRG however was eliminated by changes in the rate of exchange. If we consider the changes in the rate of exchange, we get the following comparison figures: FRG 207 percent, Great Britain 134 percent, and Italy 198 percent. Compared to Great Britain, there is thus a considerable cost pressure arising in the German aircraft and aerospace industry and that pressure can be balanced out only through the most modern production methods.

The change in aircraft production in recent years, along with the abrupt rise in cutting production methods, moved automation into the realm of possibility. A comparison of the production of the mid-section of the fuselage for the F-104-G Starfighter with the mid-section of the fuselage plus the wing box of the Tornado will illustrate this.

Production Comparison

Manufacturing share	F-104G	Tornado
Cutting	14%	44%
Noncutting shaping	29%	11%
Surface treatment	6%	9%
Assembly expenditure	51%	36%
Sum	100%	100%

Compared to the F-104, the cutting expenditure for the Tornado more than tripled. This example clearly shows the transition from the differential to the integral construction method. In the past, parts of the aircraft structure were put together from many sheet metal parts by means of connection elements such as rivets and screws; today they are milled from the entire, complete material.

The computer-controlled, integrated, and automated CIAM (Computerized Integrated and Automated Manufacturing) production system, with the CIAM machining subsystem was developed for cutting. The brain of this system is a computer grouping consisting of the production control computer, which is operated from the production control stand, the operations computer and three process computers for automatic tool cycle (tool system computer), the next-higher machine control setup, the DNC (Direct Numerical Control) computer, and the material cycle (material system computer). The core of the entire system consists of 28 processing machines, mostly large-surface milling machines with up to six spindles which are controlled by the DNC computer. In order to make optimum use of these expensive machines (each has a price tag of up DM3.5 million on it), it was necessary to reduce the machine setup and preparation times to an absolute minimum. The machines were equipped with a second setup station and automatic tool exchange mechanisms. The machines are supplied with material and material is removed from them in two separate cycles.

The tool cycle is a grouping of automatic tool preparation and positioning depots, tool commissioning, automatic tool inventory depot, and tool preparation grouping controlled by the tool system computer. By means of an automatic overhead tool transport system, the magazines of the tool exchange mechanism on the machines are supplied with tools and the used tools are removed. In this fashion, 1,500 tool changes are performed each month.

Material supply is controlled by the material system computer in conjunction with the automatic material readiness depot, the material depot as such, the automatic production equipment preparation depot, and the work piece control. Material and mechanisms are transported to the machines by floor-based, inductively controlled transport carts. The chips (cutting degree about 85 percent of material input) are separated by material types, they are moved out of the shop below the floor level, and they are supplied to the recycling stage.

For wing box assembly, Augsburg has two of Europe's biggest electron ray welding systems with a ray gun capacity of 30 kw and a chamber volume of 46 m^3. Here it is possible to weld work pieces with a thickness of 100 mm together in a vacuum. By means of electron ray welding one can get a rectangular welding seam with a thickness-to-width ratio of 40:1. Rejects and warped pieces connected with complicated and heavily-cut work pieces can be avoided and, besides, the welding seam is distinguished by a high degree of purity. In a first step, two box halves, consisting of the lower carrier plate, as well as the side and front walls, are welded together and this is followed by the welding connection of the right-hand and left-hand box halves into the welded box which is annealed in the vacuum furnace and which is shot-peened for surface consolidation.

For the series production of the Tornado's fuselage mid-sections, engineers selected a line production system which is subdivided into a structure line and an equipment line. During the work process as such, the assembly objects move within a defined station time from one assembly station to the next. By means of this system one can achieve a higher degree of division of labor and a higher degree of mechanization. Structural and equipment assembly is in each case started by means of eight time steps; a double assembly line is available for the installation of the equipment, due to the longer running time. The fuselage mid-sections

are suspended in a rotatable fashion and thus assure ergonomically favorable access especially since the ideal working height can be adjusted by means of special lifting stages.

Quality Testing Integrated into Machine Operating Cycle

In aircraft construction, quality assurance throughout the entire production time is a necessity that must be properly documented. The expenditure for this purpose however can be reduced through production automation. In the assembly and equipment lines, all testing processes are integrated into the corresponding cycles. For overall electrical testing, the fuselage mid-sections run through an automatic testing station so that only completely tested and documented components leave the factory, specifically, tested from the first to the last work operation.

One thing that is striking in the Augsburg Plant is the fact that there are so few people around. All one can see is the operator (in German he is called the machine attendant) plus the engineers. Transportation is fully automated. The work stations are clean and pleasant to man. Work is being done in two shifts because the expensive operating equipment must be kept running. There is no piece work here.

A new phase in aircraft construction is approaching as a result of the use of CFK and other sandwich materials. The first two of four prototypes of a Tornado elevator assembly are being made in Augsburg; this unit is being developed by MBB together with British Aerospace. This tail assembly is distinguished by the fact that not only the skin but also the structural spars consist of CFK.

Other primary tasks in the field of new technologies include the milling of large, spherically curved honeycomb cores for highly-stressed CFK structural parts, high-speed milling of aluminum and other raw materials, superplastic shaping of titanium sheet metal parts with complicated structural geometry, and work on industrial robots as handling systems for mechanical processing, electrical production, assembly, and quality testing.

The joint European-American F-16 Production Program

The joint procurement of the General Dynamics F-16 combat aircraft by the air forces of Belgium (116), Denmark (58), the Netherlands (at first only 102, now 124 with annual release of 20-22 in each case), and Norway (72) was referred to as the "aircraft sale of the century" after the U.S. Air Force had already reported a requirement of 1,388 aircraft.

Final assembly for the aircraft to be used by Belgium and Denmark takes place in Gosselies and the F-16 aircraft for Holland and Norway are assembled by Fokker at Schiphol.

FN is providing the lion's share in license production of the Pratt & Whitney F100 engine; this order was placed directly through the U.S. Air Force which then "supplies" the engines; FN is doing this by means of supplier shipments through Kongsberg (Norway, fan drive), Disa (Denmark, reduction gears), and Philips (Holland, afterburner). In addition to those already mentioned, there are other companies which are involved in this effort (see list below).

Essential parts are also being made by General Dynamics in Fort Worth for the entire program, such as the radome with the fuselage bow, the forward portion of the fuselage with the cockpit, the ejection seat, the cockpit hood, the rudder, the vertical tail surface skin plates, and the elevator.

By the end of January 87 F-16 aircraft had run through final assembly in Gosselies and 85 had come out of Schiphol.

The program thus is precisely in the time frame spelled out years ago without any delays.

Belgium	MBLE	Radar computer
Denmark	Dannebrog	Flight control computer
		Radar operating unit
	Per Udsen	Vertical fin
	Standard Electric	Flight control part
	Jorgen Hoyer	Nose flap adjustment motors
	Quitzau	Heat exchangers
	Nea-Lendberg	Sensor components
	Rovsing & NESELCO	Fire control computers
	Radartronics	Frequency dial, 40-kva generator
	Silcon	Transformer
Holland	DAF	Landing gear
	Signaal	Radar antenna
	Oldelft	Radar screen
	Simmonds	Fuel supply indicator
Norway	Nordisk	Outside fuel tanks
	Standard Electric	IFF unit
	Raufoss	Main radar
	Kongsberg	Inertial platform
		Nonlocking brakes
		Weapons management instrument
	NERA	Radar frames

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